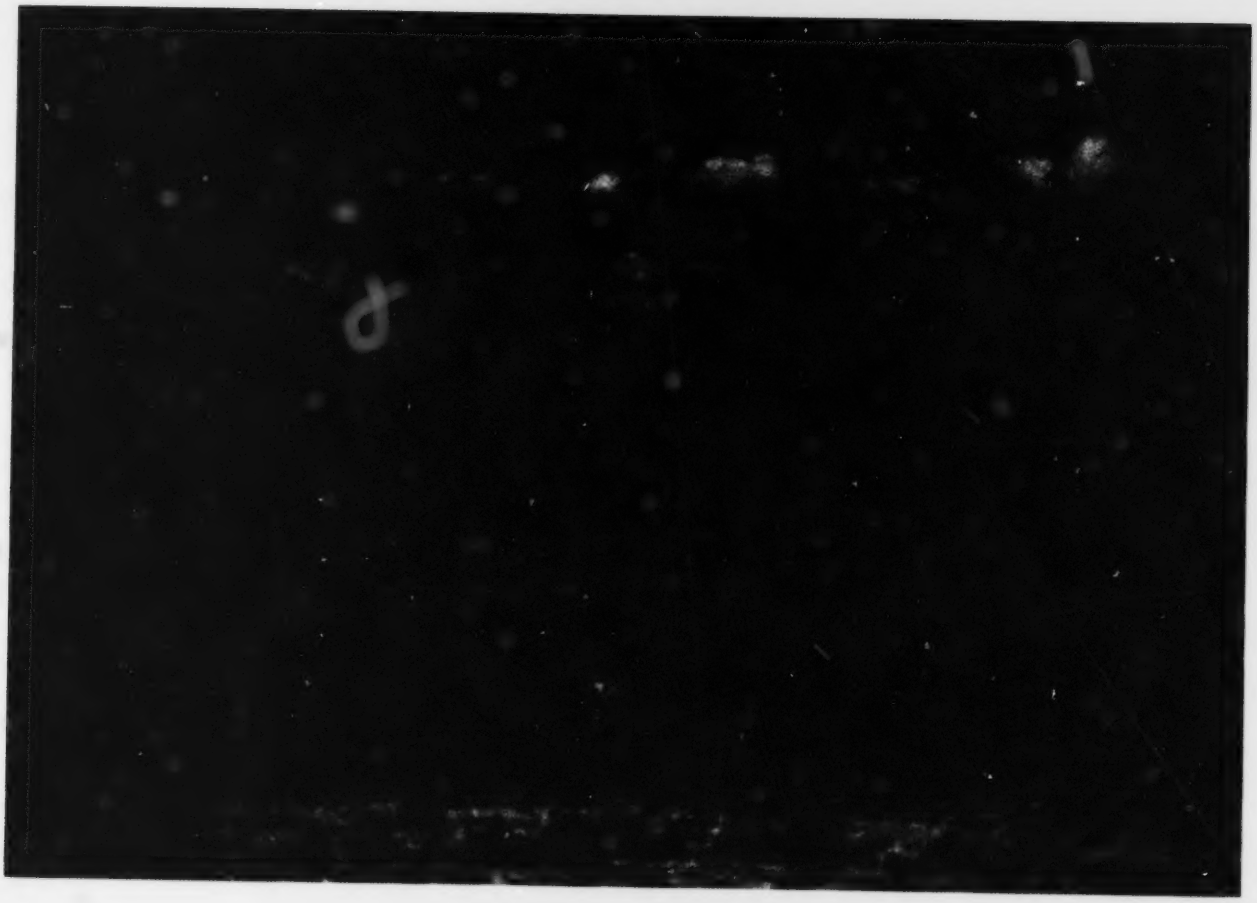
Bulletin No. 54

# Soil survey of the Calgary urban perimeter

R.A. MacMillan



ALBERTA RESEARCH COUNCIL

Terrain Sciences Department

# Soil survey of the Calgary urban perimeter

R.A. MacMillan

Alberta Soil Survey Report No. 45

*Cover:*
Landscape near Priddis, Alberta
Photo: R.A. MacMillan

TERRAIN SCIENCES DEPARTMENT, ALBERTA RESEARCH COUNCIL
EDMONTON, ALBERTA, CANADA 1987

90-01795/



# Acknowledgments

The Soil Survey of the Calgary urban perimeter was conducted by the Terrain Sciences Department, Alberta Research Council, as part of a joint project involving Agriculture Canada and the University of Alberta. These three organizations form the Alberta Institute of Pedology.

Funds for the field work and for compilation of the soil maps were supplied by the Alberta Research Council. Costs of laboratory analyses were shared through cooperation between the Research Branch, Agriculture Canada and the Terrain Sciences Department, Alberta Research Council. The soil maps were digitized and published by the cartographic section, Land Resource Research Centre, Agriculture Canada, Ottawa. Laboratory space was provided by the University of Alberta. Aerial photographs and field maps were obtained from the Resource Evaluation Branch, Alberta Forestry, Lands and Wildlife. Figures and maps in this report were prepared by Research Council Graphic Services. The Editing and Publishing Department produced this report.

The author wishes to acknowledge the contributions made by the following persons to the successful completion of the project:

R.J. Fessenden, Head, Terrain Sciences Department, Alberta Research Council, who provided the support necessary to complete this report.

J.D. Lindsay, Head (retired), Soils Department, Alberta Research Council, who provided valuable guidance and assistance throughout the project.

W.W. Pettapiece, Officer in Charge, Agriculture Canada, Alberta Soil Survey, who, as provincial correlator, contributed significantly to the concepts and content of this report.

J. Lutz, who completed the very time-consuming compilation and editing tasks.

Z. Widtman and J. Dlask for assisting in the drafting of manuscript maps and illustrations. W. Hutniak and his Graphic Services staff for final preparation of figures and plates.

The staff of the Editing and Publishing Department who did final editing, typesetting, layout and production of this report.

A. Schwarzer, W.C. McKean and J. Beres for technical laboratory assistance.

D. Ben-Oliel for compilation of information used in graphs, tables and appendices.

B. Chong, Margaret Anne Hooper and Kathy Gates for typing and assisting in the preparation of this report.

L.J. Knapik and G.M. Greenlee for guidance and assistance during the initial project stages.

S.R. Moran and D.N. Proudfoot for consultation and field assistance with regard to the surficial geology of the study area.

J. Corbin for contributing to the descriptions of the study area vegetation.

R. Carlyle, B. Bramford, H. Thorne, F. Rubis and A. Marston who kindly permitted soil climate monitoring stations to be maintained on their properties.

R. Howitt and G.M. Greenlee for their considerable efforts in reviewing the manuscript and in responding to queries from the editors during the author's two-year absence.

P. Sanborne, D. Karasek, L. Nikiforuk, D. Henderson, K. Bessie and S. McKellar, who made important contributions while working as summer field assistants.

Finally, the author would like to thank the land owners and residents of the study area, who were consistently accommodating, helpful and interested.

Note: Reports such as this often use virtually intact passages extracted from previously published material. The author would like to acknowledge the following soil survey reports which were used as source documents:

1. Soil Survey of Richland County, Ohio, USDA, Soil Conservation Service (Redmond et al., 1975).
2. Soils of the Boissevain-Melita Area, Manitoba Soil Survey Report No. 20 (Eilers et al., 1978).
3. Soil Survey and Interpretations of the Wapiti Map Area, Alberta Research Council, Bulletin No. 39 (Twardy et al., 1980).
4. Soil Survey and Land Evaluation of the Hinton-Edson Area, Alberta Research Council, Report No. 31 (Dumanski et al., 1972).
5. Guidebook for use with Soil Survey Reports of Alberta Provincial Parks and Recreation areas, Alberta Research Council, Earth Sciences Report No. 81-1 (Greenlee, 1981).

**Copies of this report are available from:**

Edmonton:
Alberta Research Council
Publications Sales
250 Karl Clark Road
Edmonton, Alberta
Canada

Phone (403)450-5111

*Mailing address:*
Alberta Research Council
Publications Sales
PO Box 8330
Postal Station F
Edmonton, Alberta
Canada T6H 5X2

Calgary:
Alberta Research Council
Publications Sales
3rd Floor
6815 - 8 Street NE
Calgary, Alberta
Canada T2E 7H7

Phone (403)297-2600

# Contents


Acknowledgments ..... ii
Abstract ..... 1
Introduction ..... 1
Part I - Location and physical environment of the study area ..... 2
Location and extent ..... 2
Drainage ..... 2
Physiography ..... 4
Rocky Mountain Foothills Division ..... 4
Alberta Plains Division ..... 5
Bedrock geology ..... 7
Stratigraphy and structure ..... 7
Tertiary and Upper Cretaceous formations ..... 7
Cretaceous formations ..... 8
Mesozoic formations ..... 8
Surficial materials ..... 9
Glacial history ..... 9
Till deposits ..... 11
Glaciolacustrine deposits ..... 13
Glaciofluvial deposits ..... 14
Post-glacial deposits ..... 15
Hydrogeology ..... 15
Groundwater supplies ..... 16
Groundwater chemistry and flow ..... 16
Climate ..... 16
Climatic variability ..... 17
Climate and land use ..... 18
Vegetation ..... 19
Vegetation regions ..... 20
Part II - Soil survey concepts and procedures ..... 22
Soil genesis ..... 23
The soil profile ..... 23
The processes of soil formation ..... 23
The factors of soil formation ..... 25
Soil classification ..... 27
Brunisolic soils ..... 28
Chernozemic soils ..... 28
Gleysolic soils ..... 28
Luvisolic soils ..... 28
Organic soils ..... 28
Regosolic soils ..... 28
Solonetzic soils ..... 28
Soil mapping ..... 28
Scientific basis of soil mapping ..... 28
Field procedures and mapping conventions ..... 29
Reliability and variability of soil units ..... 29
Comparison with the ecological land classification system ..... 31
Explanatory notes on the soil map and legend ..... 31
Soil map notations ..... 32
Part III - Descriptions of the soil groups and soil units ..... 32
Key to the soils of the Calgary urban perimeter ..... 33
Academy (ADY) ..... 33
ADHP 1 ..... 33
ADHP 2 ..... 33
ADHP 3 ..... 33
Antler (ATL) ..... 36
ATL 1 ..... 36
ATL 2 ..... 36
ATL 3 ..... 37
ATL 5 ..... 37
Balzac (BZC) ..... 37

BZC 1
BZC 2 ..... 37
BZC 3 ..... 38
BZC 4 ..... 38
Bearspaw (BPW) ..... 38
BPW 1 ..... 38
Beddington (BED) ..... 39
BED 1 ..... 39
BED 2 ..... 39
BED 3 ..... 40
Bow Valley (BOV) ..... 40
BOV 1 ..... 40
BOV 2 ..... 41
Bragg Creek (BRG) ..... 41
BRG 1 ..... 41
Connop (CON) ..... 41
CON 1 ..... 42
Delacour (DEL) ..... 42
DEL 1 ..... 42
DEL 2 ..... 42
DEL 3 ..... 43
DEL 4 ..... 43
DEL 5 ..... 44
DEL 6 ..... 44
DEL 7 ..... 44
DEL 8 ..... 44
DEL 9 ..... 45
DERK 1 ..... 45
DERK 2 ..... 45
DeWinton (DWT) ..... 45
DWT 1 ..... 45
DWT 2 ..... 46
DWT 3 ..... 46
DWHP 1 ..... 46
Dunvargan (DVG) ..... 46
DVG 1 ..... 46
DVG 2 ..... 47
DVG 3 ..... 47
DVG 4 ..... 47
DVFS 1 ..... 48
DVFS 2 ..... 48
Eastbow (EBO) ..... 49
EBAD 1 ..... 49
EBAD 2 ..... 49
Elbow-Robinson (ELRS) ..... 50
ELRS 1 ..... 50
ELRS 2 ..... 51
ELRS 3 ..... 51
ELRS 4 ..... 51
Fish Creek (FSH) ..... 51
FSH 1 ..... 51
FSH 2 ..... 52
FSH 3 ..... 52
FSH 4 ..... 53
FSH 5 ..... 53
Happy Valley (HPV) ..... 53
HPAD 1 ..... 54
HPAD 3 ..... 54
HPAD 4 ..... 55
HPSC 1 ..... 55
HPV 1 ..... 55
HPV 2 ..... 55
HPV 3 ..... 55
56

Highwood (HIW) . . . . . 56
HIBO 1 . . . . . 56
HIW 1 . . . . . 56
Indus (IND) . . . . . 56
IND 1 . . . . . 56
IND 2 . . . . . 57
Leighton Centre (LTC) . . . . . 57
LTC 1 . . . . . 57
LTC 2 . . . . . 58
Lloyd Lake (LLK) . . . . . 58
LLK 1 . . . . . 58
LLK 2 . . . . . 59
LLK 3 . . . . . 59
LLK 4 . . . . . 59
Mesa Butte (MSB) . . . . . 60
MSB 1 . . . . . 60
Midnapore (MDP) . . . . . 61
MDP 1 . . . . . 61
MDP 2 . . . . . 62
MDAD 1 . . . . . 62
MD-L 1 . . . . . 62
Nose Creek (NSK) . . . . . 63
NSK 1 . . . . . 63
NSK 2 . . . . . 63
NSK 3 . . . . . 63
Pothole Creek (POT) . . . . . 64
POT 1 . . . . . 64
POT 2 . . . . . 64
POT 3 . . . . . 65
Rockyview (RKV) . . . . . 65
RKAD 1 . . . . . 65
RKAD 2 . . . . . 65
RKAD 3 . . . . . 66
RKAD 4 . . . . . 66
RKAD 5 . . . . . 66
Rough Broken (RB) . . . . . 66
RB 1 . . . . . 67
RB 2 . . . . . 67
RB 4 . . . . . 67
RB 5 . . . . . 67
Sarcee (SRC) . . . . . 67
SRC 1 . . . . . 67
SRC 2 . . . . . 68
SRC 3 . . . . . 68
SRC 4 . . . . . 68
Spruce Ridge (SPR) . . . . . 68
SPR 1 . . . . . 69
SPR 2 . . . . . 69
Spy Hill (SPY) . . . . . 69
SPY 1 . . . . . 70
SPY 2 . . . . . 70
Strathcona (SCO) . . . . . 71
SCO 1 . . . . . 71
SCO 2 . . . . . 71
SCO 3 . . . . . 71
Sundre (SUD) . . . . . 71
SUD 1 . . . . . 72
Terric Mesisol (TM) . . . . . 72
TM 1 . . . . . 72
Tweedsmuir (TWS) . . . . . 72
TWS 1 . . . . . 72
TWS 2 . . . . . 73
Twin Bridges (TBR) . . . . . 73
. . . . . 73

TBR 1 ..... 73
Part IV - Interpretation of soils of the Calgary urban perimeter ..... 73
How to use the soil maps and interpretations tables ..... 74
Computer-derived interpretive maps ..... 74
Limitations in the use of this map and report ..... 74
Kinds of soil interpretations ..... 74
Agricultural interpretations ..... 74
Soil capability classification for dryland agriculture ..... 75
Application of soil capability ratings to soil units ..... 75
Estimates of susceptibility to soil erosion ..... 76
Estimates of probable yields of common crops ..... 76
Non-agricultural (pedotechnical) interpretations ..... 76
The engineering significance of pedological surveys ..... 76
Pedotechnical information for engineers and technical planners ..... 77
Interpretations ratings for land-use planners ..... 77
Definitions of the soil interpretation classes ..... 77
References ..... 77

Appendix A Descriptions, laboratory data and interpretations for pedons representative of soil series ..... 119
Appendix B Soil climate data for six sites within the map area ..... 121
Appendix C Evaluation of soil variability of selected soil units and soil series ..... 205
Appendix D Vegetation species list ..... 217
Appendix E Complete symbol and descriptive legends for all soil units within the map area ..... 223

Glossary ..... 224

**Tables**

Table 1 Bedrock geology of the study area—Stratigraphic column (after Green, 1972) ..... 7
Table 2 Grouping of soil units according to parent materials ..... 10,11
Table 3 Correlation of names for the major till sheets found in the Calgary urban perimeter survey area ..... 12
Table 4 Climatic data for selected stations within or adjacent to the study area ..... 18
Table 5 Relationship between vegetation zones and physiographic subdivisions within the Calgary urban perimeter survey area ..... 20
Table 6 Definition of Soil Horizon Symbols pertinent to the Calgary urban perimeter survey area (after Canada Soil Survey Committee, 1978) ..... 24,25
Table 7 Key to the classification of soil series mapped in the Calgary urban perimeter survey area ..... 27
Table 8 Statistical evaluations of Calgary urban perimeter survey area soil units ..... 30
Table 9 Comparison of mapping system approaches and terminology ..... 31
Table 10 Index to the location of soil unit information ..... 34,35
Table 11a Agricultural interpretations of the study area soil units ..... 79,80
Table 11b Estimates of probable yields of common crops in the Calgary urban perimeter survey area for some Calgary area soil units ..... 81
Table 12 Non-agricultural (pedotechnical) interpretations of the Calgary urban perimeter survey area soil units ..... 82-99
Table 13 Recreational interpretations of the Calgary urban perimeter soil survey units ..... 100-105
Table 14 Guide for developing soil interpretations for sources of topsoil ..... 106
Table 15 Guide for developing soil interpretations for sources of sand or gravel ..... 107
Table 16 Guide for developing soil interpretations for sources of roadfill ..... 108
Table 17 Guide for developing soil interpretations for road location ..... 109
Table 18 Guide for developing soil interpretations for permanent buildings ..... 110
Table 19 Guide for developing soil interpretations for trench type sanitary landfills ..... 111
Table 20 Guide for developing soil interpretations for septic tank absorption fields ..... 112
Table 21 Guides for assessing soil limitations for shallow excavating (urban services) ..... 113
Table 22 Guides for assessing soil limitations for pond reservoir areas and sewage lagoons ..... 114
Table 23 Guides for assessing soil susceptibility to water erosion ..... 115
Table 24 Guide for developing soil interpretations for fully serviced campgrounds ..... 116
Table 25 Guide for developing soil interpretations for picnic areas ..... 117
Table 26 Guide for developing soil interpretations for trails ..... 118

**Figures**

Figure 1 Sketch map of Alberta showing locations of surveyed areas for which soil reports have been published since 1941 ..... 3
Figure 2 Location and extent of the Calgary urban perimeter survey area ..... 4
Figure 3 Physiographic subdivisions of the Calgary urban perimeter survey area ..... 5
Figure 4 Schematic cross section of the Calgary urban perimeter survey area geology and physiography ..... 8

Figure 5 Bedrock geology of the Calgary urban perimeter survey area (after Green, 1972) ..... 9
Figure 6 Distribution of soil parent materials in the Calgary urban perimeter survey area ..... 11
Figure 7 Schematic illustration of till sheet distribution and likely ice movement directions in the Calgary urban perimeter survey area ..... 13
Figure 8 Illustration of likely conditions controlling the formation of proglacial lakes at successively lower elevations from west to east within the study area ..... 15
Figure 9 Groundwater chemistry of the Calgary urban perimeter survey area ..... 17
Figure 10 Locations and graphical summary of data for climate stations within or bordering the Calgary urban perimeter survey area ..... 19
Figure 11 Generalized distribution of agroclimatic zones within the Calgary urban perimeter survey area ..... 20
Figure 12 Generalized vegetation zones of the Calgary urban perimeter survey area ..... 21
Figure 13 Diagram of a soil profile showing various horizons ..... 23
Figure 14 Geologic time scale ..... 27

**Plates**

Plate 1 Priddis Valley subdivision ..... 5
Plate 2 Calgary Laking Basin subdivision ..... 6
Plate 3 Okotoks Benchland subdivision ..... 6
Plate 4 Leighton Centre Upland ..... 6
Plate 5 Big Hill Upland ..... 6
Plate 6 Porcupine Hills and Paskapoo formations ..... 6
Plate 7 Cretaceous formations ..... 8
Plate 8 Dunvargan soil formed on glacial till ..... 8
Plate 9 Mega-erratic ..... 12
Plate 10a Bow Valley soil group ..... 14
Plate 10b Strathcona soil group ..... 14
Plate 11 Alluvium ..... 15
Plate 12 Colluvium ..... 15
Plate 13 Foothills Valley vegetation ..... 16
Plate 14 Antler soil profile ..... 22
Plate 15 Balzac soil ..... 36
Plate 16 Beddington soil ..... 37
Plate 17 Bow Valley soil ..... 39
Plate 18 Delacour soil ..... 41
Plate 19 DEL 3 topography ..... 43
Plate 20 DEL 7 wind erosion ..... 43
Plate 21 Dunvargan soil on hill slope ..... 44
Plate 22 Eastbow soil ..... 48
Plate 23 Elbow soil ..... 49
Plate 24 Fish Creek soil ..... 50
Plate 25 Fish Creek soil slope instability ..... 52
Plate 26 Eluviation characteristic of FSH 5 soil unit ..... 53
Plate 27 Profile of a Rego Black soil included in Happy Valley soil group ..... 54
Plate 28 Lloyd Lake soil ..... 54
Plate 29 Mesa Butte soil ..... 58
Plate 30 Rockyview soil ..... 61
Plate 31 RB 1 topography ..... 66
Plate 32 Profile of an Orthic Gray Luvisol of the Spruce Ridge soil group ..... 67
Plate 33 Spy Hill soil ..... 69
Plate 34 Soil erosion during a wind storm east of Calgary ..... 70

# Abstract

*This report and four 1:50 000 maps include the results of a new soil survey of the Calgary urban perimeter. This resurvey, initiated in 1977, encompasses the region of most active development and expansion around the city of Calgary, from Tp21 to Tp26 and from R27 to R29, W4Mer., and R1 to R5, W5Mer. The results of this study include general information on the kind, characteristics, location, and areal distribution of 33 soil groups and their constituent soil units in the Calgary area and indicate the suitability of these soils for agricultural and engineering uses.*

*This was a level three, semi-detailed soil survey, in which traverses were made at approximately 1.5 to 3 m (1 to 2 mi) intervals or less, with approximately six to ten soil observations taken in every section of land. Aerial photographs and topographic maps at a scale of 1:50 000 were used to establish soil and topographic boundaries.*

*In general, the Delacour Plain contains the largest extent of Canada Land Inventory class 1 soils, which are capable of sustained production of the full suite of crops common to Alberta. These soils are dominantly Chernozemic with scattered inclusions of Gleysolic and Solonetzic Subgroups. Most are formed on medium-textured till parent materials. Smaller areas have silty aeolian or sandy glaciofluvial veneers overlying the till materials. The topography is mainly gently undulating and results in few agricultural or engineering limitations.*

*The Okotoks Benchland and Calgary Laking Basin contain dominantly Canada Land Inventory class 2 soils. A slight reduction in dependable frost free period introduces a climatic limitation to the range of crops that can be successfully cultivated on a sustained basis in these areas. The soils otherwise are generally highly fertile and productive. Almost all are Black Chernozemics with lesser inclusions of Gleysolic soils. The dominant parent materials are very fine textured glaciolacustrine, and moderately fine textured till with some fine textured glaciolacustrine. In the Okotoks Benchland, some steeper, bedrock-controlled slopes restrict both agricultural use and non-agricultural development.*

*The Big Hill, Broadcast Hill and Leighton Centre uplands contain soils mostly of CLI class 3 or poorer. The cooler climate and shorter frost free period on these upland areas is reflected in the greater extent of aspen vegetation and pasture land relative to cropland. The soils also reflect this change with Dark Gray Luvisols and Dark Gray Chernozems becoming almost as extensive as Orthic Black Chernozems. The landscape is controlled by large, flat-topped, bedrock uplands covered by a thin mantle of moderately fine textured till. Several of the uplands have thick caps of gravel between the bedrock and the till. Steeper topography and, occasionally, shallow depth to bedrock introduce more limitations for agricultural and other development than in the previously discussed areas.*

*The Priddis Valley is similar to the Calgary Laking Basin but contains mostly CLI class 4 soils or poorer. The soils are mostly fertile, productive Black Chernozems and scattered Gleysolics developed on very fine textured glaciolacustrine parent materials. They are limited principally by a short frost free period. The clayey texture, high moisture storage and lower valley bottom locations combine to create somewhat colder conditions for crop growth. Sloping topography can be limiting for some non-agricultural uses, but is not generally a problem. The Bow and Elbow valleys cut across a variety of climate zones and contain a variety of soils. Most are rated as CLI class 4 or poorer due to a range of limitations including stoniness, droughtiness, restricted frost free period or steep slopes. Almost all soils are developed on glaciofluvial or glaciolacustrine parent materials of varying thickness that overly rounded valley train gravels on the floor of both valleys. Soil textures range from silty clay slope wash along the edges of the Calgary Laking Basin to sands and gravels closer to the active channel. Slopes are level to gentle except along the steep valley sides.*

*The Rocky Mountain foothills occupy western portions of the study area and contain most CLI class 5 or 6 soils. These are dominantly Orthic and Dark Gray Luvisols developed on a thin blanket to veneer of moderately fine textured, stony till overlying ridged bedrock. Aspen or spruce vegetation predominates, and the climate is too cool for sustained production of most common crops. Steep topography is a common limitation for many uses, and shallow depth to bedrock can become a constraint for some developments.*

*Together, mapping and interpretation provide a regional overview of the soil conditions in the Calgary area and a framework for more detailed site investigations and planning. The maps indicate broad soil distribution patterns and combinations of soil likely to be found on specific land parcels. Awareness of the limited extent of high-quality agricultural land and of constraints to both agricultural and non-agricultural uses should assist in improved management in this area.*

# Introduction

A new soil survey of the Calgary urban perimeter was initiated in 1977 in response to the growing number of requests for up-to-date soil information near Calgary. This resurvey covers a portion of the area formerly included in the old reconnaissance surveys of the Blackfoot and Calgary and the Rosebud and Banff map sheets (Wyatt et al., 1942 and 1943). Information from these old surveys was presented at a mapping scale that is too broad to show soil areas in sufficient detail for many current requirements. The maps are also out of date, with respect to present knowledge of soils and systems of soil classification. This new survey benefits from advantages derived from more intensive examination of soils in the field, use of modern aerial photographs, improved methods of studying soils in the laboratory, and improved methods of presenting such data to land managers. The purpose of this report and accompanying soil maps is to provide data on the kind, characteristics, location, and areal distribution of soils in the Calgary urban perimeter survey area, and to indicate the suitability of these soils for various specified uses.

This was a level three, semi-detailed, soil survey, in which traverses were made at one to two mile intervals

or less, with approximately six to ten soil observations taken in every section of land. Aerial photographs and topographic maps at a scale of 1:50 000 were used to establish soil and topographic boundaries.

Four soil maps supplement this report. These maps, published at a scale of 1:50 000, show the main topographic features and the location and extent of the individual soil areas. Township and range numbers are shown along the margins. Soil areas are identified on the maps by simple symbols, each of which is individually described and interpreted in the accompanying report. Each soil group has a unique color and shade that are designed to assist in locating similar areas on the map and to indicate similarities and differences among the groups according to their parent materials. A descriptive legend appears on the maps as well as in the report, where map symbols are arranged and described in alphabetical order.

The report is presented in five parts. Part I outlines the location of the study area and provides a general description of its physical environment. Part II is a summary of the concepts of soil formation, classification and mapping that were used in this survey. Part III contains detailed descriptions of the soil symbols found on the maps. Soils are described on the basis of soil groups which are dominated by one parent material and one soil series. The discussion of each soil group includes a description of the physiography, drainage, topography, vegetation, climate, landform, current land use, and classification of the principal soil of that group. Also included are a non-technical description of a typical profile belonging to the group and a short comment on the major suitabilities and limitations of that soil. Each soil unit within a soil group is then described in terms of its landscape position, topography, parent materials, assemblage of component soils, variability and use limitations.

In Part IV, the soil units described in Part III are interpreted for various potential land uses. The Soil Capability for Agriculture System is used to group the soils for agricultural interpretations. Estimates are made of probable yields of common crops and relative erodibility of the various soil units. Engineering and recreation interpretations provide ratings of the suitabilities and limitations of the soil units for the following potential land uses: source of topsoil, sand, gravel or roadfill; road location; permanent buildings; shallow excavations; septic tank absorption fields; sanitary landfills; camp areas; picnic areas; and trails. The units are also rated according to their potential flooding hazard and features affecting their use as reservoir areas are noted. These interpretations appear in tables 12 and 13. Single factor, computer-derived maps for each interpretation have also been produced and are on Open File with the Alberta Research Council.

Part V consists of five appendixes that contain tables of data and other technical information. The first contains detailed descriptive, analytical, and interpretive information for each of the major soils recognized in the study area. The second contains tables and graphs of soil climate measurements taken at six sites in the study area over a two-year period. The third presents the results of intensive sampling of some of the major soil units to determine their compositional makeup and the variability of certain selected soil properties within the units and within the various soil series that compose each unit. The fourth contains a listing of common names and their latin equivalents for those plants referred to by their common names in the text. The fifth consists of the complete descriptive and symbol legends.

# Part I - Location and physical environment of the study area

## Location and extent

The Calgary urban perimeter survey area is a relatively small soil survey area in southwestern Alberta (figure 1, unit 45). It covers about 240 000 hectares surrounding the city of Calgary (figure 2) and consists of the west halves of the National Topographic Series 1:50 000 maps 82I/13 and 82P/4, all of 82O/1 and 82J/16, excluding the city of Calgary, and the Sarcee Indian and military reserves; and a small portion of 82J/15 lying east of the forest reserve boundary. This square area is about 58 km on each side and encompasses part or all of townships (Tp) 21 to 26; ranges (R) 27, 28 and 29, W4 Mer, and 1 to 4, W5 Mer, inclusive; and a small portion of Tp 22, R 5, W5 Mer. The boundaries were determined arbitrarily to cover the areas immediately affected by the rapid expansion of the city of Calgary. The mapping may eventually be extended to encompass the municipal districts (MD) of Foothills and Rockyview.

The study area is not large, but includes a wide diversity of climate and physiography. This results from the rapid transition from plains to foothills topography that occurs within the study area, and from the complex geologic history.

## Drainage[1]

The study area is drained by the Bow River and its tributaries, which form part of the Saskatchewan River basin, discharging into Hudson Bay. The Bow River rises in the Rocky Mountains and drains an area of 8122 km² above Calgary. It enters the area in the northwest corner in Tp 25, R 4, W5 Mer at an elevation of 1130 m and exits in the southeast in Tp 21, R 28, W4 Mer at an elevation of 950 m. The average mean daily discharge of the Bow River at Calgary is 92.1 m³/s (Water Survey of Canada, 1983). The major tributaries of the Bow River within the study area are the Elbow and Highwood rivers, and Fish, Threepoint and Nose

[1] Contribution of H. Hudson, Alberta Research Council, Resource Technologies Department.

creeks. Their drainage areas and mean daily discharges are as follows: Elbow River below Glenmore Dam (1230 km², 8.43 m³/s); Highwood River near the mouth (3990 km², 19.5 m³/s); Fish Creek near Midnapore (428 km², 0.36 m³/s); and Threepoint Creek near Millerville (507 km², 2072 m³/s).

The study area has a typical high-latitude runoff regime. Weaker discharges are low, and the rivers are frozen over for about five months of the year. Winter precipitation falls almost exclusively as snow, which runs off in the spring. Chinook winds may cause substantial depletion of the snowpack during the winter.

The annual flood, which usually occurs in late May or early June, is typically generated by snowmelt and may be enhanced by rainfall. Several, generally smaller, flood peaks may result from rainfall following the snowmelt. The largest of these floods occur as the result of heavy frontal rains along the foothills.

**LEGEND**

| | |
|---|---|
| 11 | Blackfoot and Calgary sheets |
| 12 | Rosebud and Banff sheets |
| 13 | Wainwright and Vermilion sheets |
| 14 | Peace Hills sheet |
| 15 | Rycroft and Watino sheets |
| 16 | Red Deer sheet |
| 17 | High Prairie and McLennan sheets |
| 18 | Grand Prairie and Sturgeon Lake sheets |
| 19 | Rocky Mountain House sheet |
| 20 | Beaverlodge and Blueberry Mountain sheets |
| 21 | Edmonton sheet |
| 22 | St. Mary and Milk River project |
| 23 | Cherry Point and Hines Creek area |
| 24 | Buck Lake and Wabamun Lake area |
| 25 | Grimshaw and Notikewin area |
| 26 | Hotchkiss and Keg River area |
| 27 | Whitecourt and Barrhead area |
| 28 | Chip Lake area |
| 29 | Tawatinaw map sheet 83I |
| 30 | Mount Watt and Fort Vermilion area |
| 31 | Hinton-Edson area 83F |
| 31a | North Saskatchewan River Valley |
| 33 | Waterton Lakes National Park |
| 34 | Sand River sheet |
| 35 | Two Hills county |
| 36 | Oyen sheet |
| 38 | Elk Island National Park |
| 38a | M77-3 NW Lethbridge |
| 38b | M80-3 NE Lethbridge |
| 39 | Wapiti Map area |
| 40 | Brazeau Dam |
| 41 | Newell county |
| 42 | Athabasca Oil Sands area |
| 43 | Iosegun sheet |
| 44 | Banff-Jasper National Parks |
| 45 | Calgary Urban Perimeter |
| 46 | Warner county |
| 58-1 | Preliminary |
| 59-1 | Preliminary |
| 60-1 | Preliminary |
| 61-1 | Preliminary |
| 62-1 | Preliminary |
| 63-1 | Preliminary |
| 64-1 | Preliminary |
| 64-2 | Preliminary |

Note: Reports published prior to 1942 are out of print but may be obtained on loan from the Alberta Soil Survey. These include: Macleod sheet, Medicine Hat sheet, Sounding Creek sheet, Peace River, High Prairie, Sturgeon Lake area, Rainy Hills sheet, Sullivan Lake sheet, Lethbridge and Pincher Creek sheets, Milk River sheet, Rosebud and Banff sheets, and Wainwright and Vermilion sheets.

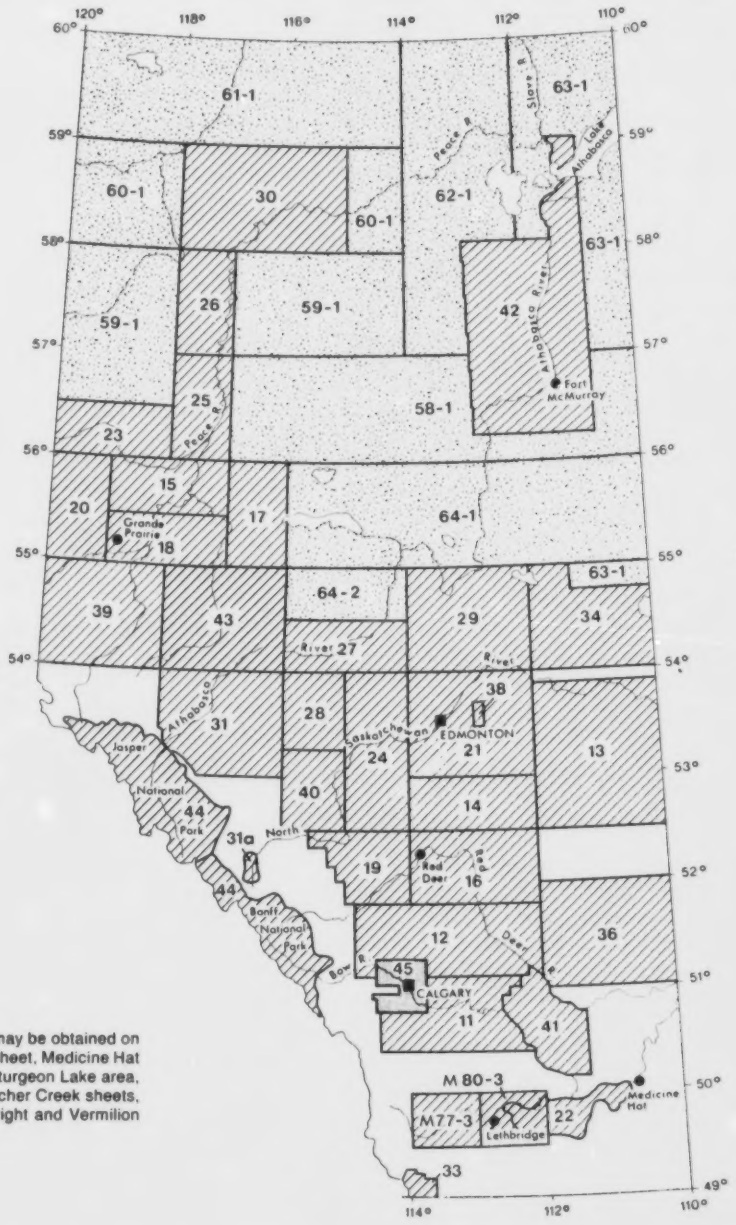



**Figure 1.** Sketch map of Alberta showing locations of surveyed areas for which soil reports have been published since 1941.

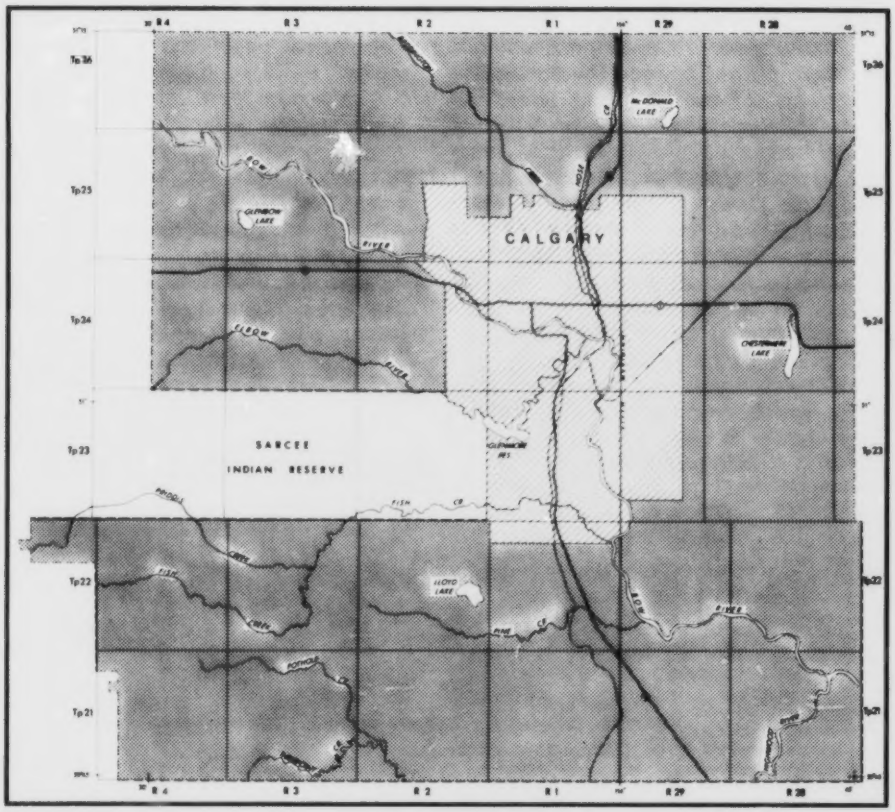



**Figure 2.** Location and extent of the Calgary urban perimeter survey area.

## Physiography

The physiography of an area plays an important role in both soil formation and land use. It is related to such factors as elevation, aspect, slope, surface pattern and drainage. In the Calgary area, glacial drift is generally thin, and most large-scale physiographic features are related to bedrock configuration and topography (Tharin, 1960). More subtle features occur in areas of deep glacial deposits, or in molded or hummocky till.

Bostock (1970) recognizes two physiographic divisions within the survey area. They are the Rocky Mountain Foothills Division of the Cordilleran Region and the Alberta Plains Division of the Interior Plains Region. For the purpose of this survey, these areas have been further subdivided on the basis of local characteristics of relief and topography (figure 3).

### Rocky Mountain Foothills Division

The Rocky Mountain Foothills Division is defined by the presence of disturbed (faulted and folded) bedrock lying to the west of the Jumpingpound-Grand Valley thrust fault. Two subdivisions have been recognized, based on differences in relief, topography and associated soils.

*Foothills subdivision*

The Foothills subdivision occupies most of the Rocky Mountain Foothills Division in the area. It consists of a series of parallel, northwest-southeast trending hogback ridges and intervening valleys. The ridges have summit elevations ranging from 1250 m to 1525 m. They are generally strongly sloping, whereas the valleys are broad and gently sloping and become more narrow and steeper toward the west. The valleys are filled with thick deposits of till and glaciolacustrine sediment, whereas the ridges have only a thin veneer of till or colluvium. Soils on the north and east sides of ridges have formed in cool, moist conditions and are strongly leached. Those soils on the south and west slopes, which developed under warmer, drier conditions, are less strongly leached, or not leached. The principal soils are those of the Spruce Ridge, Fish Creek and Dunvargan soil groups.

*Priddis Valley subdivision*

The Priddis Valley is a region of transition between the foothills and the plains. The surface is undulating to gently rolling and is composed principally of very fine, clayey glaciolacustrine sediment with occasional outcroppings of till-covered ridges, which are isolated extensions of the foothills. The glaciolacustrine material is found between 1180 and 1255 m, whereas the ridges occur up to 1300 m. The Priddis Valley is dominated by dark-colored, clayey Fish Creek soils. The slightly stony, dark-colored soils shown in the foreground of plate 1 are formed on till and belong to

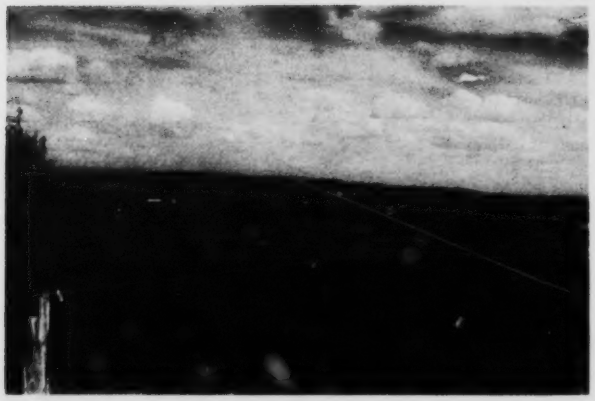


**Plate 1.** Priddis Valley subdivision

the Dunvargan soil group. The forested ridge in the background is dominated by lighter-colored, leached soils belonging to the Leighton Centre soil group.

### Alberta Plains Division

The Alberta Plains Division is taken as that portion of the area east of the ridged foothills that is underlain by flat-lying bedrock belonging mainly to the Paskapoo Formation (see Bedrock geology). Elevations decrease eastward down the regional slope from 1350 m in the west to 1050 m in the east. Subdivisions of the Alberta Plains have been recognized, from differences in relief and topography. Changes in predominant soils are associated with these physiographic subdivisions.

*Calgary Laking Basin subdivision*

The Calgary Laking Basin is transitional to, and sometimes continuous with, the Priddis Valley. It is characterized by a gently undulating to gently rolling glaciolacustrine plain. The surface material has a high silt content and occurs between 1080 and 1300 m. The clay content of this glaciolacustrine deposit appears to increase toward the western edge of the basin. The broad, level plain occupying the center of plate 2 is typical of the Calgary Laking Basin. It is dominated by dark-colored, fine, silty Lloyd Lake soils. The depression in the foreground is the Bow Valley. At this point, the gravels of the Bow Valley are covered by a thick wedge of fine, silty sediments eroded from the adjoining basin and transported into the valley through the draws and gullies developed along the valley sides. The principal soils in this subdivision are those of the Lloyd Lake, Fish Creek and Bearspaw soil groups.

*Okotoks Benchland subdivision*

The Okotoks Benchland is a transition region between the relatively level, low-lying Delacour Plain to the east

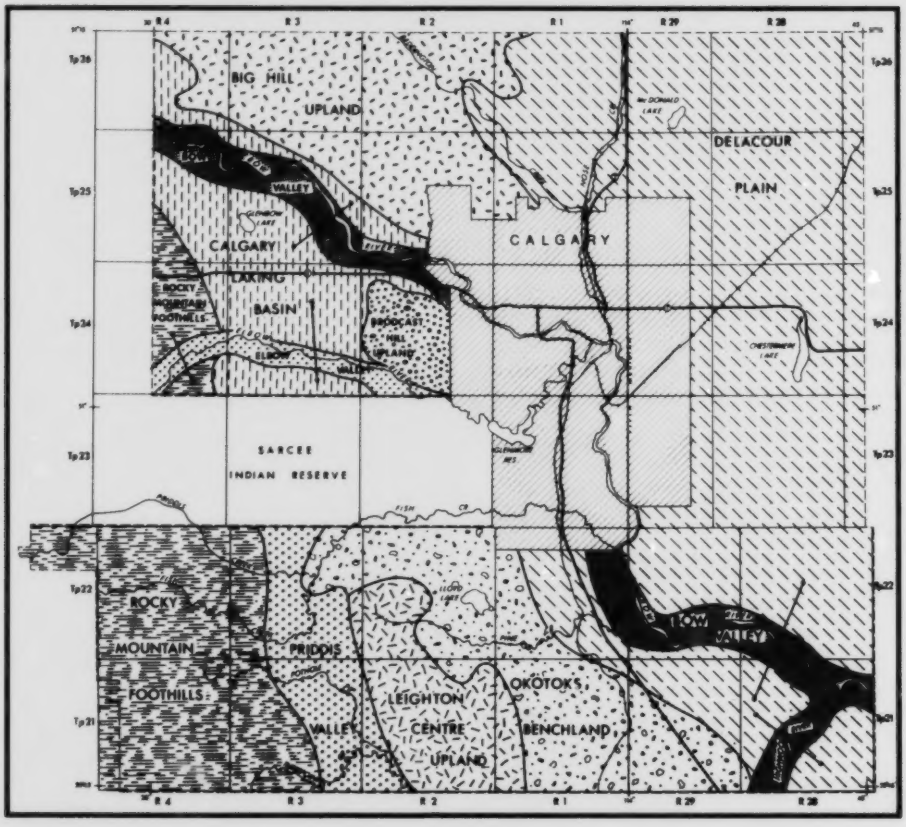



**Figure 3.** Physiographic subdivisions of the Calgary urban perimeter survey area.

**Plate 2.** Calgary Laking Basin subdivision

**Plate 3.** Okotoks Benchland subdivision

and the Leighton Centre, Big Hill and Broadcast Hill Uplands to the west. It consists of eroded remnants of flat-lying, till-covered bedrock highs rising above a low-lying plain of ground moraine and scattered glaciolacustrine deposits. The basins are located at about 1100 m, and the bedrock highs occur to a maximum of about 1220 m. Maximum elevations decrease eastward down the regional slope. Rolling topography characteristic of the Okotoks Benchland subdivision is displayed on plate 3. The level terrain in the foreground is part of a small glaciolacustrine basin. Dark-colored, fine, silty Lloyd Lake soils occupy this landscape position. The rolling hills in the background are eroded remnants of an original flat-lying bedrock upland. They are covered with a thin blanket of glacial till and are dominated by dark-colored Antler soils. The principal soils mapped in the subdivision belong to the Antler, Lloyd Lake and Rockyview soil groups.

*Leighton Centre Upland subdivision*

The Leighton Centre Upland is a large, flat-topped bedrock high, covered with a mantle of till. Steep slopes occur where the upland rises from the surrounding plain and where it has been dissected by preglacial erosion. Elevations range from 1140 m at the base to 1320 m at the highest point. The rolling, bedrock-controlled topography is characteristic of the Leighton Centre Upland (plate 4). An abrupt change in land use occurs between the Okotoks Benchland pictured in the foreground and the Leighton Centre Upland in the background. Aspen forest and cleared pasture occur in about equal amounts in the Leighton Centre landscape. Typically, the soils found under the aspen vegetation (Leighton Centre) are lighter in color and more strongly leached than the soils in naturally open glades (Dunvargan). The soils belong mainly to the Leighton Centre and Dunvargan soil groups.

*Big Hill and Broadcast Hill Uplands subdivision*

These uplands are similar in many respects to the Leighton Centre Upland. They too consist of till-covered, flat-topped bedrock highs. Gravel deposited over the bedrock in preglacial times helped to protect the surface of the uplands from erosion and to maintain the present relief. Till overlies the gravel and mantles the sides of the upland areas. Normally, the till is about 3 to 4 m thick, but in several areas of hummocky topography, it is as much as 30 m thick. The Uplands occur above the surrounding plain—located at 1180 m—to elevations of 1220 to 1340 m. Plate 5 shows the long, smooth slopes found on the Big Hili upland. Hummocky topography is found in the forested area seen in the far background. Dark-colored Dunvargan and Antler soils are found on the smooth topography, and Spy Hill soil

**Plate 4.** Leighton Centre Upland

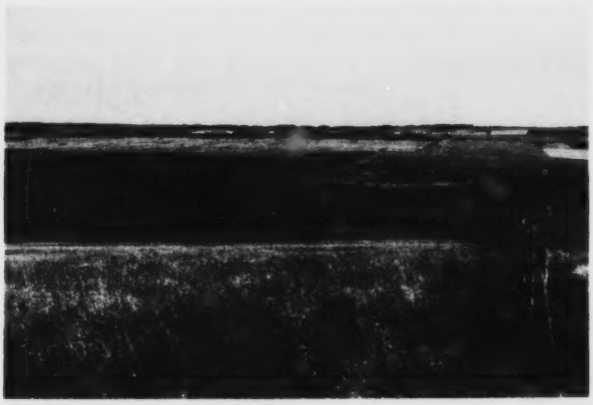


**Plate 5.** Big Hill Upland

occurs in hummocky areas. The main soils mapped on the uplands belong to the Spy Hill, Antler and Dunvargan soil groups.

*Delacour Plain subdivision*

The Delacour Plain subdivision is a low-relief till plain of undulating to gently undulating topography. It is recognized below 1140 m in the north and 1080 m in the south of the mapped area. Most of the relief is due to glacial features, such as meltwater channels, eskers, washboard moraine and minor flutings. The principal soils belong to the Academy, Rockyview, Midnapore, Happy Valley and Eastbow soil groups.

*Bow Valley subdivision*

The Bow Valley subdivision maintains a unique character, while cutting across both the physiographic divisions (figure 3). The sides of the valley are steep and cut through as much as 100 m of till and glaciolacustrine sediment. The valley floor consists of flat-lying, valley train gravel, overlain toward the valley sides by gently sloping fans and aprons composed of material eroded from adjacent upland areas. Bedrock is exposed, in places, along the present channel of the Bow River. The principal soils belong to the Bow Valley, Highwood and Lloyd Lake soil groups and Rough Broken (RB) miscellaneous land types.

*Elbow Valley subdivision*

The Elbow Valley transects several subdivisions in a manner similar to the Bow valley (figure 3). It is characterized by steep sides that frequently form unvegetated cliffs of glaciolacustrine material. The valley floor consists of a wet, low-lying channel in which gravel and loam occur in a braided pattern. A few small terraces are better drained and have a substantial cover of loamy material over the gravel. The main soils belong to the Twin Bridges and Sarcee soil groups and RB miscellaneous land types.

## Bedrock geology

In soil investigations, the underlying bedrock is of interest because it contributes to the soils' parent material, it determines the regional physiography through structural control and differential erosion, and it affects interpretations of land use when it occurs at, or near, the surface. In the Calgary area, sedimentary rocks, mainly of Tertiary and Cretaceous age, form the underlying bedrock.

### Stratigraphy and structure

Table 1 presents a stratigraphic column for the area in which bedrock units are arranged and described vertically by age from youngest to oldest (Green, 1972). A schematic cross section has been devised that shows the structural and stratigraphic relationships (figure 4), and the distribution of bedrock in the mapped area is shown in figure 5.

### Tertiary and Upper Cretaceous formations

The youngest bedrock formations mapped in the Calgary area are late Cretaceous to Tertiary in age.

**Table 1.** Bedrock geology of the study area—stratigraphic column (after Green, 1972).

| | |
|---|---|
| **Tertiary**<br>Tp | Porcupine Hills Formation: pale gray, thick-bedded, cherty, calcareous sandstone, pale gray calcareous mudstone: nonmarine |
| **Tertiary and Cretaceous**<br>**TKp** | (Alberta Plains)<br>Paskapoo Formation: gray to greenish gray, thick-bedded, calcareous, cherty sandstone; gray and green siltstone and mudstone; minor conglomerate, thin limestone, coal and tuff beds; Scollard Member (Ksc): gray feldspathic sandstone, dark gray bentonitic mudstone; thick coal beds; nonmarine |
| **TKb** | (Rocky Mountain Foothills)<br>Brazeau Formation: greenish gray, thick-bedded, chloritic and feldspathic sandstone and blocky gray mudstone; some tuff and thin coal beds; nonmarine |
| **Cretaceous**<br>**Ka** | Alberta Group: dark gray, fissile, silty shale; some thin-bedded, fine- to medium-grained, cherty sandstone (Blackstone Formation) - thick-bedded, well-sorted, quartzose sandstone; dark gray shale and carbonaceous shale; siltstone and thin coal beds (Cardium Formation) - dark gray fissile shale and siltstone; thin-bedded, fine-grained, glauconitic sandstone; thin beds of concretionary ironstone (Wapiabi Formation) - Note: north of Athabasca River, areas designated as Ka include Smoky Group, Dunvegan and Shaftesbury formations (stratigraphic equivalents of Alberta Group) |
| **Mesozoic**<br>**Mz** | Lower Cretaceous, Jurassic and Triassic: dark gray to black siltstone; dolomitic siltstone and limestone; silty dolomite, limestone, breccia and gypsum (Triassic) -dark gray to black fissile shale and siltstone; black cherty and phosphatic dolomite and limestone; green glauconitic shale and sandstone (Jurassic) - thick-bedded, fine- to coarse-grained, cherty sandstone interbedded with dark gray shale, siltstone and coal (Nikanassin and Kootenay formations) -gray, siliceous, calcareous sandstone; green chloritic and feldspathic sandstone; dark gray carbonaceous and calcareous shale; gray, green and red shale and silty shale; some conglomerate; coal in central and northern Foothills; trachytic tuff, agglomerate in southern Foothills (Blairmore Group). |

Three separate formations of that time period have been recognized. They are the Porcupine Hills, Paskapoo and Brazeau formations.

*Porcupine Hills and Paskapoo formations*

Flat-lying, Tertiary age, non-marine sedimentary rocks underlie most of the mapped area. Carrigy (1971) recognizes two units: the Paskapoo Formation and the somewhat younger Porcupine Hills Formation. Earlier authors (Allan, 1943; Tharin, 1960) did not recognize the latter unit. Both units are predominantly thick-bedded, calcareous, cherty sandstone with accompanying siltstone and mudstone (Green, 1972). The

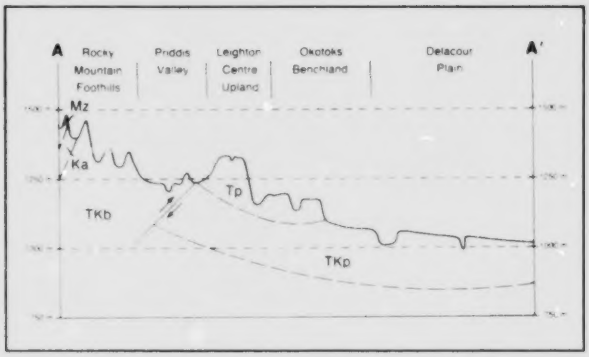



**Figure 4.** Schematic cross section of the Calgary urban perimeter survey area geology and physiography.

sediments occur in a trough-like depression, known as the Alberta Syncline, so that older formations outcrop both east and west of the Paskapoo Formation (Allan, 1943). The composition of glacial tills found in the Calgary area is strongly affected by incorporation of sand grains and angular fragments weathered from this rock (plate 6). Numerous historic buildings in Calgary were constructed of sandstone quarried from these formations. Remnants of the Porcupine Hills Formation, which have been protected from erosion, project above the surrounding plains to form the flat-topped Leighton Centre and Big Hill-Broadcast Hill Uplands (see Physiography).

*Brazeau Formation*

The Jumpingpound-Grand Valley thrust fault marks the boundary between the foothills and the plains. West of this fault, the bedrock units are no longer flat-lying, but are faulted and folded. The youngest rocks are Tertiary, non-marine, thick-bedded, chloritic and feldspathic sandstone and blocky gray mudstone belonging to the Brazeau Formation (Green, 1972). This unit includes sediment, that has been described (Allan, 1943) as belonging to the Cretaceous Edmonton and Belly River formations. Most of the foothill ridges in the area are composed of erosion-resistant sandstone and conglomerate beds from this formation.

**Cretaceous Formations**

The next oldest rocks to outcrop within the area belong to the Cretaceous Age Alberta Group. Three formations are included in this group (Green, 1972). They are, from youngest to oldest, the upper Alberta-Wapiabi Formation, the Cardium Formation and the lower Alberta-Blackstone Formation. The Wapiabi Formation underlies much of the southwestern portion of the area; the Cardium and Blackstone formations outcrop only rarely. The ridges found in the Foothills portion of the survey area consist of faulted and folded sandstones and shales. Steeply dipping shales with minor sandstone lenses are covered by a thin blanket of stony Cordilleran till (plate 7). These shales probably belong to the cretaceous Wapiabi Formation.

*Wapiabi Formation*

The Wapiabi Formation is dominantly dark gray, fissile, marine shale with thin layers of fine-grained, glaucanitic sandstone. It is as much as 520 m thick. Most of the valleys in the foothills of the Calgary area have been eroded into this formation.

*Cardium Formation*

The Cardium Formation consists of about 90 m of thickly bedded quartzose sandstone with dark gray carbonaceous shale and siltstone. Because it is resistant to erosion, it forms ridges where it reaches the surface.

*Blackstone Formation*

The Blackstone Formation is composed of as much as 290 m of dark gray, fissile, silty marine shale with minor amounts of fine- to medium-grained cherty sandstone. It is easily eroded and some of the more westerly foothills valleys are cut into this formation.

**Mesozoic Formations**

A few of the highest ridges in the southwestern portion of the map area are composed of Mesozoic strata of early Cretaceous, Jurassic and Triassic ages. The oldest formation reported to outcrop in the area is the Lower Cretaceous Blairmore Group (Glendenning, 1974), which consists mainly of gray to green sandstone and dark gray, green and red shale.

**Plate 6.** Porcupine Hills and Paskapoo formations

**Plate 7.** Cretaceous formations

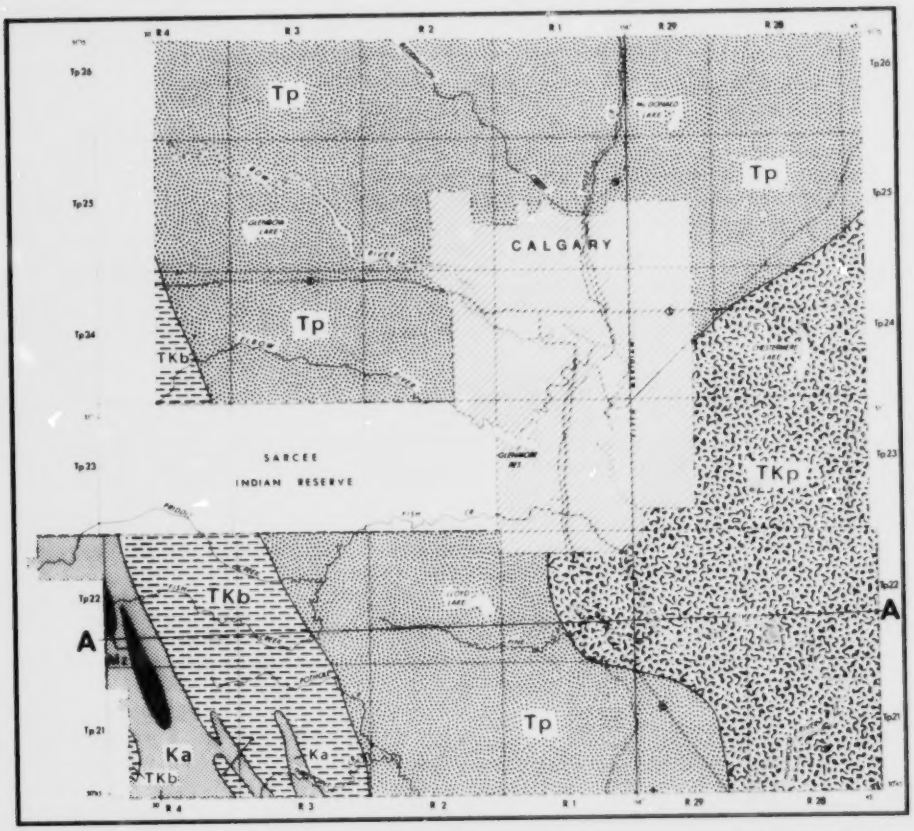



**Figure 5.** Bedrock geology of the Calgary urban perimeter survey area (after Green 1972).

## Surficial materials

Many of the properties of soils that affect their use or classification are controlled by the nature of the parent geologic material. Some of these properties are inherited directly from the parent material, whereas others are developed during pedogenesis, but reflect the influence of the original material. In soil mapping, differences in parent material constitute an important criterion used to define different soils. These parent material differences result from variations in the geologic processes of erosion, transportation and deposition that have affected the earth's surface.

In the Calgary area, as in most parts of Canada, glaciers covered all of the land surface during parts of the Pleistocene Epoch. They molded the landscape and deposited surficial materials, either directly from the ice as glacial till, or in associated bodies of glacial meltwater as glaciolacustrine or glaciofluvial sediment. Consequently, the distribution of surficial materials is explained primarily in terms of the glacial history of the area. Postglacial activity has resulted in slight alterations to glacial sediments and in deposition of minor amounts of recent sediments.

Table 2 groups the soils mapped in the Calgary area according to the parent materials in which they formed and indicates the percentage of the map area covered by each soil and parent material. Fourteen different parent material combinations have been recognized for the 104 soil units defined for this survey. Figure 6 shows the general distribution of these deposits in the survey area.

### Glacial history

The glacial history of the Calgary area has been studied by many investigators, beginning in 1858 with James Hector, a geologist with the Palliser Expedition. G.M. Dawson, as early as 1883, recognized the importance of the region in determining the Pleistocene history of the continent. The major features of the area's surficial geology were recognized by Dawson and McConnell in 1895. They observed that tills deposited from western mountain ice (Cordilleran) and from eastern continental ice (Laurentide) met in the area and were separated by a zone where the till appeared to be of mixed origin. Much subsequent work has been directed at sorting out the chronology and distribution of these different glacial deposits. Recent studies dealing with all or parts of the area include those of Tharin (1960), Morgan (1966), Glendenning (1981), Nowack (1977), Jackson (1977), and Moran (1986). The reader is referred to these publications for a more detailed account of the glacial history of the area than that which appears here. The terminology and names adopted by Proudfoot et al. (1981) for description of the surficial geology of the study area are used in this section.

**Table 2.** Grouping of soil units according to parent materials.

| Geologic origin | Parent material description | Soil group | Soil unit | % of total area |
|---|---|---|---|---|
| **Till** Cordilleran (Bow Valley) till | Fine loamy to fine clayey, dark grayish brown, moderately to very stony till. Stone fraction consists of black to dark gray limestone and pink or purple quartzite. Characteristically very dense, compact till with numerous stones. | Spruce Ridge | SPR 1-2 | 7.1 |
| | | Spy Hill | SPY 1-2 | |
| Laurentide (Crossfield) till | Fine loamy, grayish brown, slightly stony till. Stone fraction contains abundant granitic and gneissic pebbles and lesser amounts of dark-colored carbonate pebbles. | Academy-Happy Valley | ADHP 1-3 | 25.3 |
| | | Beddington | BED 1-3 | |
| | | Delacour | DEL 1-9 | |
| | | Delacour-Rockyview | DERK 1-2 | |
| | | Nose Creek | NSK 1-3 | |
| Mixed (Balzac) till | Fine silty to fine clayey, grayish brown to dark grayish brown, moderately stony till. Stone fraction consists of tan and yellow limestone and quartzite, dark gray limestone, pink and purple quartzite and occasional granitic or gneissic rocks. | Antler | ATL 1-3 | 23.8 |
| | | | ATL 5 | |
| | | Dunvargan | DVG 1-4 | |
| | | Leighton Centre | LTC 1-2 | |
| Undifferentiated till | May display any combination of properties described for above tills. Also includes till-like materials formed by readvance of glaciers over previously deposited materials. | Dunvargan-Fish Creek | DVFS 1-2 | 3.6 |
| | | Rough Broken | RB 1 | |
| | | | RB 4 | |
| **Glaciolacustrine** Dominantly clay | Very fine to fine clayey, dark gray to dark grayish brown, stone free to slightly stony, glaciolacustrine sediments. Usually massive. Irregular bedding and large inclusions of flow type till noted in some vertical exposures. Fine lamallar varves found in some locations. | Elbow-Robinson | ELRS 1-4 | 8.8 |
| | | Fish Creek | FSH 1-5 | |
| Dominantly silt | Fine silty to fine clayey, grayish brown to olive brown, predominantly stone free, glaciolacustrine sediments. Reworked surface often suggests late stage aeolian or glaciofluvial influence. Bedding is weak to absent. Characterized by very high silt content and correspondingly high content of calcium carbonate. | Lloyd Lake | LLK 1-4 | 6.8 |
| | | Bearspaw | BPW 1 | |
| | | Rough Broken | RB 5 | |
| **Glaciofluvial** Valley train gravels | Well-rounded, well-sorted, dominantly gravel-sized material derived predominantly from carbonate rocks. | Bow Valley | BOV 1-2 | 1.0 |
| | | Bragg Creek | BRG 1 | |
| | | Sundre | SUD 1 | |
| Ice-contact gravels | Irregular assemblage of angular to well-rounded, poorly sorted, dominantly gravel-sized material derived predominantly from carbonate rocks but also including large boulders, and sandstone or shale fragments. Often contains significant amounts of coarse sand, or silt and clay. | Strathcona | SCO 1-3 | .8 |
| Sandy outwash | Sandy to coarse loamy, dark yellowish-brown to grayish brown, stone free to slightly stony, glaciofluvial outwash. Surface meter often contains appreciable silt or clay suggesting late stage aeolian or alluvial influence. Deposits are not extensive or uniform in the map area and often grade imperceptibly into adjacent materials. | Connop | CON 1 | 4.6 |
| | | Happy Valley | HPV 1-3 | |
| | | Happy Valley-Academy | HPAD 1 | |
| | | | HPAD 3 | |
| | | | HPAD 4 | |
| | | Happy Valley-Strathcona | HPSC 1 | |
| | | Highwood | HIW 1 | |
| | | Highwood-Bow Valley | HIBO 1 | |
| | | Midnapore | MDP 1-2 | |
| | | | MD-L 1 | |
| | | Midnapore-Academy | MDAD 1 | |
| | | Twin Bridges | TBR 1 | |
| **Recent deposits** Lacustrine | Very fine to fine clayey, dark gray to grayish brown, stone free, recent lacustrine that has accumulated depressions in the landscape. Massive. | Balzac | BZC 1-4 | 7.0 |
| | | DeWinton | DWT 1-3 | |
| | | DeWinton-Happy Valley | DWHP 1 | |
| | | Indus | IND 1-2 | |
| | | Creek | POT 1-3 | |
| Alluvium | Fine to coarse loamy, very dark gray to grayish brown slightly to moderately stony, recent alluvium. Highly variable. Vertical exposures often display alternating dark and light colored layers and corresponding changes in | Sarcee | SRC 1-4 | 3.0 |
| | | Tweedsmuir | TWS 1-2 | |

| | | | | |
|---|---|---|---|---|
| | textural composition. Found in currently active or recently abandoned stream channels or sometimes as fan or apron deposits at the base of steep slopes. | | | |
| Colluvium | Thin veneer of highly variable texture and color derived from weathering and downslope movement of underlying bedrock. | Mesa Butte<br>Rough Broken | MSB 1<br>RB 2 | 1.2 |
| Aeolian | Fine silty to fine clayey, gray to light brownish gray, stone free to slightly stony, thin, discontinuous aeolian veneer overlying till. Characterized by high silt content and high calcium carbonate content. | Eastbow-Academy<br>Rockyview | EBAD 1-2<br>RKAD 1-5 | 6.6 |
| Organic | Moderately to highly decomposed fen peat generally less than 1.6 m in depth. Usually overlain by a surface layer of fibric peat composed of sphagnum mosses. | Terric-Mesisol | TM 1 | .3 |

**Till deposits**

Soils formed in glacial till cover the largest proportion of the map area (59 percent). Till is defined (Gary et al., 1972) as unsorted, unstratified drift, deposited directly by or underneath a glacier (plate 8). The glaciers that deposited till in the Calgary area advanced from several different source areas. Thus, differences in the composition and properties of these tills can be explained in terms of the paths along which the glaciers advanced and the rocks and sediments over which they passed. The names commonly given to the major till sheets and their correlatives in other parts of Alberta are presented in table 3.

Three major source areas are recognized for tills found in the Calgary area (figure 7). The western portion of the area is covered by till that has a Rocky Mountain origin and was deposited by ice that advanced eastward from the mountains. The eastern portion is covered by till deposited by a Laurentide glacier that advanced westward from centers west of Hudson Bay. The central part of the survey area contains a mixed till that has properties characteristic of both eastern and western tills. It is thought by some to have been deposited by a glacier that advanced out of the Athabasca and other major valleys north of Calgary and was deflected southeast upon encountering the margin of the Laurentide glacier.

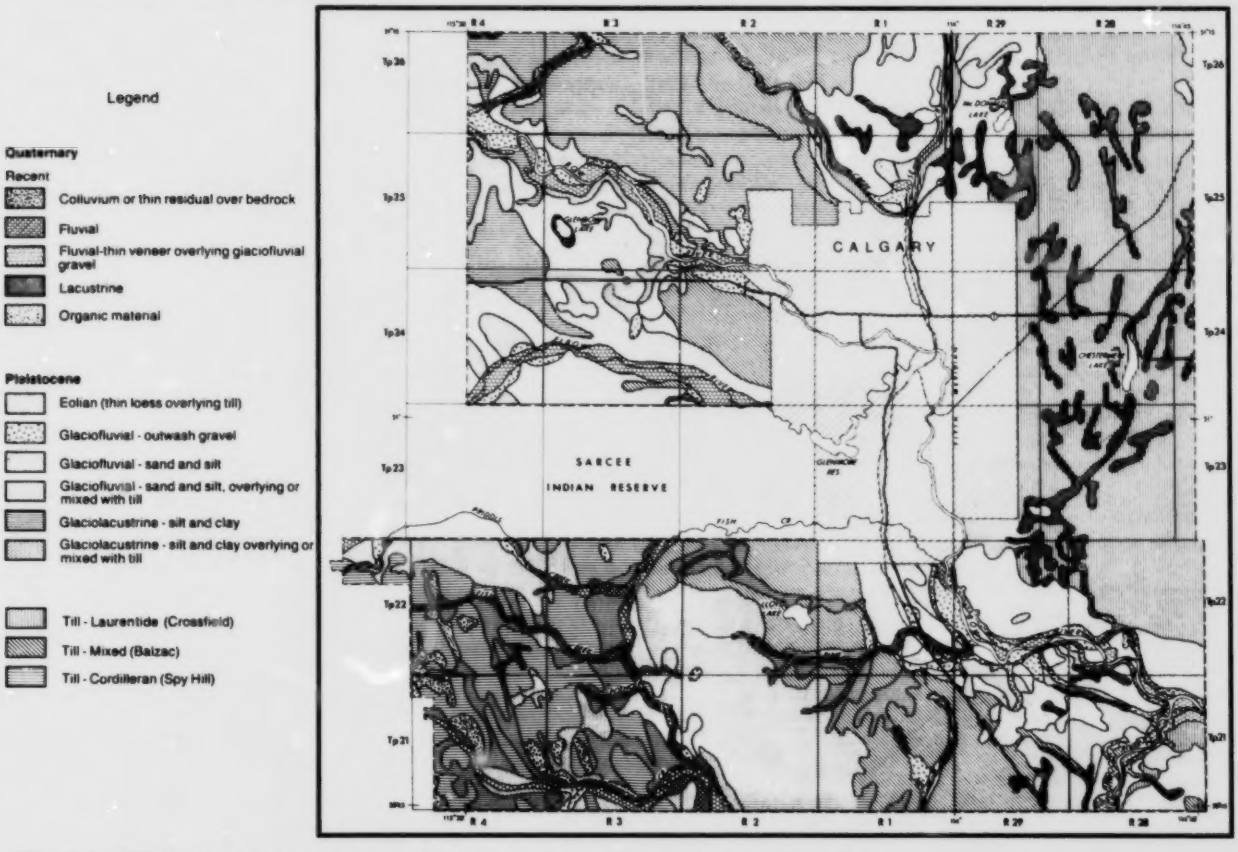



**Figure 6.** Distribution of soil parent materials in the Calgary urban perimeter survey area.

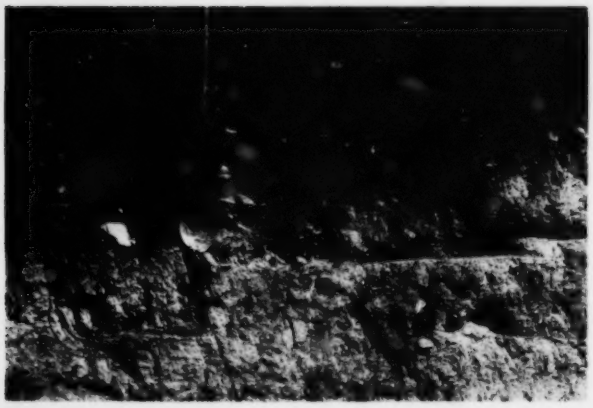


**Plate 8.** Dunvargan soil formed on glacial till (photo by L. Knapik)

*Cordilleran tills*

Rutter (1972) recognized four separate advances of western glaciers. The pre-Bow Valley till was deposited by the earliest advance and has been largely removed by erosion and subsequent glaciations. It is not found at the surface, and, within the study area, is preserved only in a few deep valleys where it is buried under the surface tills. The two youngest advances, Canmore and Eisenhower Junction, were minor in extent and did not reach as far as the study area. Thus, the till that occurs at the surface over most of the eastern foothills, is associated with Rutter's Bow Valley advance, which has been dated at about 25 000 years (BP). Proudfoot et al. (1981) accept the name Spy Hill drift (Tharin, 1960) for this till. It is the oldest of the surface stratigraphic units in the Calgary area. They describe it as generally heavy textured with a grain size composition of 15 to 20 percent sand, 40 to 45 percent silt and 40 to 45 percent clay. The abundant pebble fraction is "characterized by dark gray to black limestone and pink or purple banded quartzite".

Bow Valley till is associated with strongly bedrock-controlled topography. It generally occurs as a veneer about 1 to 3 m thick overlying moderately to steeply sloping ridged bedrock and occasional flat-topped bedrock highs. Thicker accumulations occur in valley bottoms, but in these locations, the till is generally buried beneath glaciolacustrine sediment. In valleys where it is not buried, it frequently displays hummocky topography characterized by short, complex, moderately steep slopes and numerous wet depressions or ponds.

*Laurentide (Continental) tills*

Three tills of Laurentide origin have been recognized in the Calgary area (Stalker, 1960). The older Maunsel and Labuma tills have been removed or buried, and nowhere do they occur at the surface. The last Laurentide advance deposited the Buffalo Lake (or Crossfield) till, which forms the surface till over the eastern portion of the map area (roughly that described by the Delacour Plain physiographic subdivision). Moran (in Proudfoot et al., 1981) describes the Crossfield till as being characterized by a texture of 30 to 35 percent sand, 30 to 40 percent silt and 25 to 30 percent clay. It contains abundant granitic and gneissic pebbles derived from the Canadian Shield and lesser amounts of carbonate pebbles of Rocky Mountain origin. He differentiates two units of this till based on morphological features.

Crossfield till occurs most commonly as low-relief ground moraine on gently undulating to gently rolling topography. It is occasionally thick and masks underlying bedrock irregularities. Where meltwater channels have been eroded into bedrock, the resultant till-covered slopes are generally bedrock controlled. Scattered flutings, till-covered eskers and subdued washboard moraine add some relief to the otherwise featureless ground moraine surface. Portions of the Crossfield till are overlain by thin, discontinuous deposits of silty loess.

*Mixed till*

The mixed till found in the central portion of the study area appears to have formed as a result of coalescence of Cordilleran and Laurentide ice masses. It is most frequently referred to as erratics train till due to the zone of mega erratics (plate 9) with which it is associated (Stalker, 1956). Moran (in Proudfoot et al., 1981) refers to this till as Balzac drift. Most evidence suggests that the mega erratics originated as a rockfall onto the surface of the glacier near Mount Edith Cavell, Jasper, and that their distribution marks the

**Table 3.** Correlation of names for the major till sheets found in the Calgary urban perimeter survey area.

| Source area | Name used in this report | Alternate names for same unit within the study area | Names of units of similar age and provinance outside study area |
|---|---|---|---|
| Western till (Cordilleran) | Bow Valley till (Rutter 1972) (Fenton and Moran 1981) | Spy Hill till (Tharin 1960, Nowack 1981)<br>Till A (Glendenning 1973)<br>Morley till (Tharin 1960, Nowack 1976) | Raven Creek (Roed 1968)<br>Marlboro (Roed 1968)<br>Lamoral (Boydell 1972)<br>Earnst (Alley 1973) |
| Mixed till (Cordilleran and Laurentide) | Balzac till (Tharin 1960) (Fenton and Moran 1981) | Erratics train till (Morgan 1966, Jackson 1976, Nowack 1979)<br>Till B (Glendenning 1973) | Mixed till (Roed 1968)<br>Athabasca (Boydell 1972) |
| Eastern till (Laurentide) | Crossfield till (Tharin 1960) (Fenton and Moran 1981) | Buffalo Lake till (Stalker 1960, Alley 1973)<br>Laurentide till (Morgan 1966, Glendenning 1973) | Edson/Maybern (Roed 1968)<br>Sylvan Lake till (Boydell 1972) |

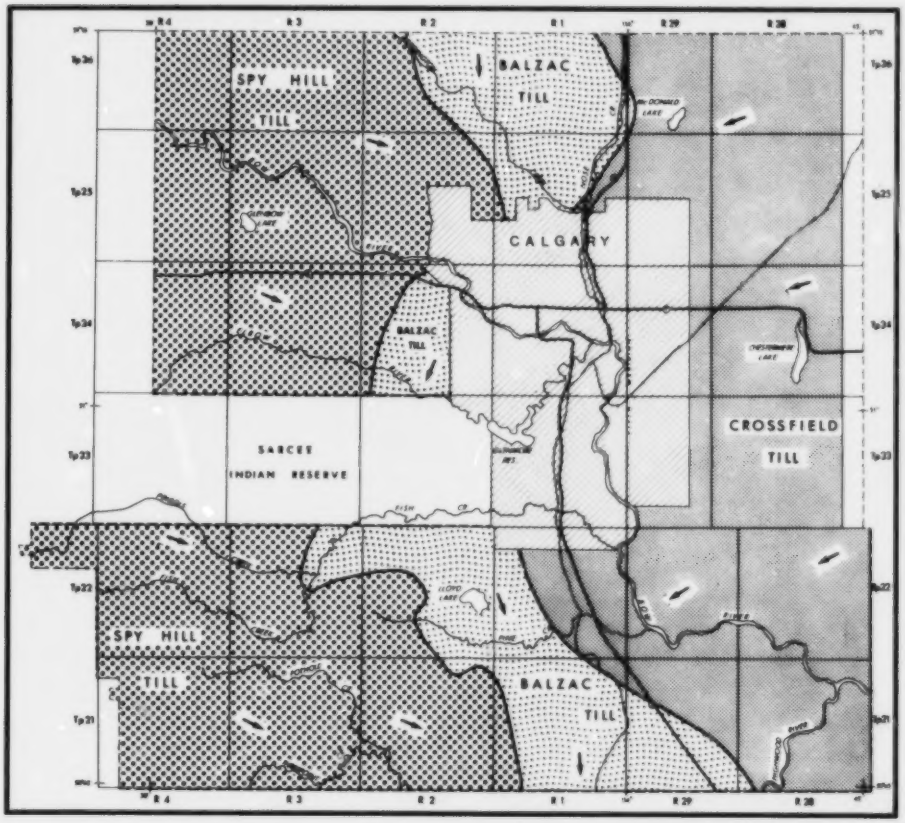



**Figure 7.** Schematic illustration of till sheet distribution and likely ice movement directions in the Calgary urban perimeter survey area.

path subsequently followed by the ice (Morgan, 1966; Jackson, 1976; Roed, 1968). Proudfoot et al. (1981) present stratigraphic arguments for the separation of the mixed till into two units: the Balzac and Lochend tills. They, however, recognize the lithological similarity of the two tills and, for purposes of this survey, have not separated them. Both tills are described as being silty, with a grain size composition of 10 to 20 percent sand, 45 to 60 percent silt and 20 to 40 percent clay. The till is commonly stony and contains abundant fragments of Tertiary and Cretaceous sandstone and siltstone. The pebble fraction contains abundant tan and yellow limestone and quartzite rocks, in addition to rocks similar to the Spy Hill drift. Granitic and gneissic rocks are present, but rare.

Balzac till is found on a wide variety of landscapes. It is generally associated with gently undulating to gently rolling ground moraine where it ranges in thickness from 2 to 20 m. It also forms a smooth mantle, 1 to 3 m thick, over numerous flat-topped, steep-sided, bedrock highs. Hummocky moraine, developed in this mixed till, is found along the sides of the Spy Hill Upland and in a few locations around the edge of the Leighton Centre Upland. Till in the hummocky areas is characteristically deep (20 to 30 m thick), massive and stony. Slopes are complex, short and generally in the range of 6 to 15 percent.

**Glaciolacustrine deposits**

Glaciolacustrine sediment, forming the secondmost common soil parent material (15 percent), ranges from coarse-textured sand associated with shorelines, deltas and shallow-moving water environments, to finer-textured silt and clay associated with deeper, quiet water environments. Most of the glaciolacustrine sediment mapped in the area is fine textured. It was deposited mainly in proglacial lakes that formed where meltwater was trapped between the margins of retreating glaciers and the regional slope (figure 8). It is thought that the mixed ice of the erratics train glacier was responsible for the damming of most of these lakes (Jackson, 1976; Morgan, 1966). As it retreated eastward, the glacier downwasted and exposed successively lower channels for the escape of dammed water. Thus, the earliest lakes formed in the western portion of the map area and occurred at the highest elevations. As the glacier melted down and retreated eastward, successive lakes formed at lower elevations.

Jackson (1976) reports that glacial Lake Bragg deposited sediment to an elevation of up to 1400 m. Some of these older glaciolacustrine sediments are mapped along the Bragg Creek road from Priddis Creek Estates to Fish Butte. In the narrow valleys bordering the forest reserve south of Bragg Creek, glaciolacustrine clay occurs as high as 1350 m. These

**Plate 9.** Mega-erratic

**Plate 10a.** Bow Valley soil group

deposits are found at increasingly lower elevations eastward to the Priddis Valley, where they occur at elevations below 1250 m. North of Cochrane, glaciolacustrine silty clay was mapped at 1300 m. Major terraces located at 1220 m indicate that, as the lake level fell, a major stillstand occurred at this elevation. These several stages of glacial Lake Calgary were responsible for the deposition of glaciolacustrine silt and clay over much of the area between Calgary and Cochrane, in the north, and the Sarcee Indian Reserve, in the south. During the final stages of Lake Calgary, it drained through a channel cut at about 1150 m; the escaping water formed a small lake in the present vicinity of Lloyd Lake and Pine Creek. Silty clay sediment was deposited in this area up to 1150 m elevation. Subsequent drainage levels at 1080 m and 1050 m did not give rise to glacial lakes.

Generally, glaciolacustrine sediments are confined to valley bottoms and basins. The topography is generally gently undulating to gently rolling. Exceptions to this rule are the supraglacial lakes and ice-walled lakes associated with areas of hummocky topography. These display moderately to strongly rolling topography controlled by the underlying hummocky till.

**Glaciofluvial deposits**

Glaciofluvial materials are sediments deposited by glacial streams on land (Thwaites, 1963). In the survey area, these deposits include gravel, sandy gravel, sand and sandy loam. They occupy only a small proportion of the total area (6 percent). The most common glaciofluvial deposits are the valley train gravels deposited by the Bow and Elbow rivers and some of the larger streams. The gravel in these deposits is generally well rounded and well sorted and is associated with the level to gently sloping topography of valley floors and terraces (plate 10a).

Ice-contact gravel was deposited in kames, eskers and along meltwater channels where flow was controlled by the glacier. These deposits are generally more angular and less well sorted than valley train gravel, and contain more large boulders and greater amounts of sand. They occur on topography that ranges from depressional to steeply sloping, and they often have an irregular or patchy distribution (plate 10b).

Where meltwater channels emptied into glacial lakes, ice-contact gravel deposits grade into deltaic deposits. The gravel in these deltas is better sorted and less angular than the ice-contact gravel, and forms deeper, more continuous deposits. The deltas generally have gently sloping surfaces, but may have moderately to steeply sloping sides.

Some outwash sand occurs adjacent to the Bow River Valley. It is well sorted at depth but, near the surface, contains appreciable amounts of finer-textured material. This inclusion of some silt and clay in the surface sandy loam indicates that it was deposited in slowly moving water, or perhaps that it received additions of fine-textured aeolian material. The topography of these deposits is usually gently sloping to undulating.

**Post-glacial deposits**

A small proportion (18 percent) of the soil parent materials of the area have been formed or deposited by non-glacial processes since the end of the Pleistocene Epoch. These include sediment of lacustrine alluvial, colluvial and aeolian origin, and scattered deposits of organic materials.

*Alluvium*

Alluvium occurs mainly in active stream channels, where it is maintained in a dynamic state by ongoing erosion, transportation and deposition. It is highly variable in texture, but is generally fine to coarse loamy. It is associated with the level to gently undulating topography of floodplains and terraces. Moderate slopes, however, do occur where stream development has dissected the floodplain or where fluvial material has accumulated at the base of steep hillsides (plate 11).

*Colluvium*

Colluvium includes material that accumulated as a result of downslope movement under the influence of gravity (plate 12). In the survey area, it occurs in small areas of steep slopes where the original glacial cover is no longer present or recognizable. In such areas, the colluvium occurs as a thin veneer, composed mainly of material weathered from the underlying sedimentary rocks, but including some traces of the former till cover. The texture of these deposits is highly variable and depends on the underlying rock type, the degree of weathering and the amounts of other materials (principally till) incorporated into the colluvium. The presence of numerous angular flags and blocks of weathered bedrock is characteristic of this material.

*Aeolian material*

Wind has been an active agent in reworking and adding material to the surface of soils in the Calgary area. It is likely that most of the soils mapped east of the foothills possess a thin surface veneer of loess. The presence of a loess cap helps to explain the notable lack of stones and the silt loam texture of the upper sola of soils developed on otherwise moderately stony loam to clay loam till. Thin, discontinuous

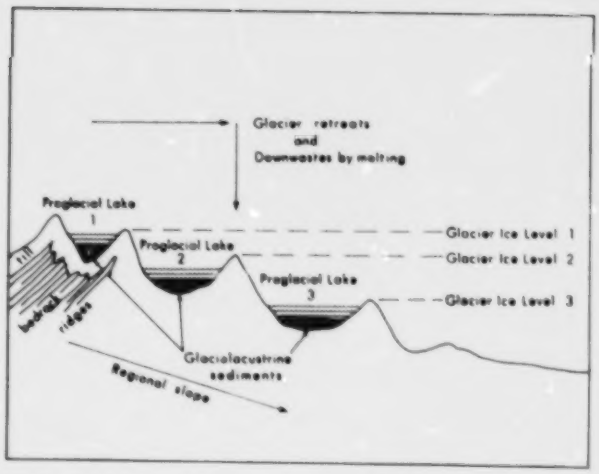



**Figure 8.** Illustration of likely conditions controlling the formation of proglacial lakes at successively lower elevations from west to east within the study area.

deposits of silty loess have been mapped adjacent to the Bow Valley east of Calgary and in the vicinity of Beddington and Nose creeks. In most cases, this silty loess lies directly on till, but in areas of Eastbow soil, it may overlie sandy glaciofluvial material or till.

*Organic material*

Organic material has developed in wet, low-lying areas. The rapid growth and slow decay of fen type vegetation in these locations has resulted in the buildup of moderately peaty material. Organic soils are mapped in the few locations where the unconsolidated peat accumulation is greater than 40 cm thick.

## Hydrogeology

The hydrogeologic environment can be a prominent factor in soil formation and land use. For example, water ponded at the surface or rising from below can result in the formation of Gleysolic soils. Solonetzic soils may form where groundwater has brought high concentrations of soluble salts to the surface. Land use is influenced by such factors as the depth to water

**Plate 10b.** Strathcona soil group

**Plate 11.** Alluvium

**Plate 12.** Colluvium

table—which affects the ability of the soil to supply crops with moisture—and the availability of groundwater for human and livestock consumption. This section summarizes pertinent information, as presented in recent Alberta Research Council hydrogeology reports.

**Groundwater supplies**

The two main sources of groundwater in the area are thick, permeable fluvial and glaciofluvial deposits, and near-surface bedrock. Clean sand and gravel deposits of considerable thickness (which receive abundant recharge from adjacent bedrock) and surface water bodies generally give the highest yields (Ozoray and Barnes, 1977). They are found in the major river valleys, along some buried channels, and on terraces and kames. The most frequent yields are 450 to 2250 L/min west of Calgary (Ozoray and Barnes, 1977) and 100 to 450 L/min east of Calgary (Ozoray and Lytviak, 1974), but rates greater than 2250 L/min and as low as 5 L/min are also recorded. Low yields occur where the deposits are mainly silt, clay-clogged sands, or well-drained gravels lacking adequate recharge. Gravel beds with low yields are found along the upper terraces of the Bow River west of Cochrane and on top of the Big Hill and Broadcast Hill Uplands.

The main bedrock aquifer for the plains portion of the area is the Paskapoo Formation (including the Porcupine Hills Formation). Most wells in the Calgary area that are completed in one or more sandstone layers of this bedrock are sufficient to satisfy domestic needs (Meyboom, 1961). The average 20-year safe yield limit has been reported to fall in the range of 24 to 120 L/min, east of Calgary (Borneuf, 1972, Ozoray and Lytviak, 1974), and 100 to 450 L/min, west of Calgary (Ozoray and Barnes, 1977). Meyboom (1961) calculates that recharge to bedrock aquifers in the area averages 11 L/min/km$^2$ (18 L/min/mi$^2$). Using this figure and normal consumption rates, he suggests that depletion of groundwater resources will occur in areas where the population density exceeds 100 to 150/km$^2$.

In the foothills, little data are available, but on the basis of lithological similarity, the Brazeau Formation is expected to have yields similar to those of the Paskapoo Formation. Deformation of foothills strata has increased secondary (fracture) permeability and introduced offsetting tectonic groundwater barriers. In the Brazeau Formation, therefore, yields may be more varied in distribution and magnitude than they are in the Paskapoo Formation.

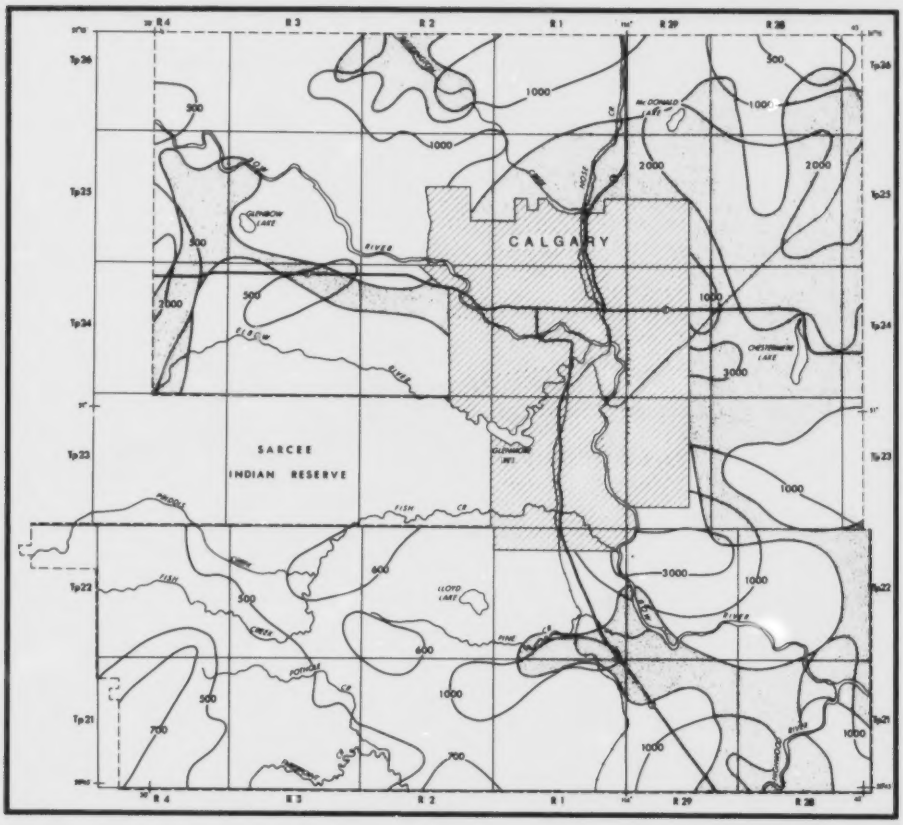
**Groundwater chemistry and flow**

Figure 9 shows the hydrochemistry of the area as constructed from chemical analysis of groundwater from the locally most-used aquifer (Ozoray and Barnes, 1977). West of the fifth meridian, water is generally hard (calcium/magnesium type), but total dissolved solids content is usually low, rarely exceeding 1000 ppm and frequently below 500 ppm. East of the fifth meridian are large areas of soft (sodium type) water. In those areas, the total dissolved solids content is undesirably high, ranging from 1000 ppm to more than 3000 ppm.

The groundwater chemistry and flow regime are closely related to the dissolved solids content. Groundwater in recharge areas is usually lower in total dissolved solids (less than 1500 ppm) than groundwater in discharge areas (more than 1500 ppm). Calcium/magnesium carbonate and bicarbonate type waters predominate in recharge areas, while sodium bicarbonate and sodium sulfate waters frequently occur in discharge areas. This pattern arises due to changes in the chemistry of groundwater as it moves along its flow path. Water that moves quickly through short distances and at shallow depths is usually high in calcium and bicarbonate. Water that remains below ground longer, and travels farther and deeper, undergoes an increase in total dissolved solids and in relative amounts of sodium and sulfate (if available) (Ozoray and Lytviak, 1974; Ozoray and Barnes, 1977).

## Climate

The climate of the Calgary area is characterized by warm summer and relatively cool winter temperatures, subject to fairly rapid fluctuation due to Chinook winds (Wyatt et al., 1942). According to the Koeppen classification, it has a Humid Microthermal climate that is cold




**Legend:**

ppm total dissolved solids

Groundwater discharge area
(sodium-sulphate type water)

Groundwater recharge area
(calcium bicarbonate type water)

**Figure 9.** Groundwater chemistry of the Calgary urban perimeter survey area.

with humid winters and cool summers (Dbf). There is a distinct climatic change from east to west that is related to increases in elevation and proximity to the Rocky Mountains. Climatic data for selected stations within or adjacent to the map area are summarized in table 4. In general, the climate of the Calgary area displays a broad, regional zonation in an east to west direction as depicted in figures 10 and 11. Annual precipitation averages between 575 and 650 mm for stations in the foothills west of Calgary and decreases to between 366 and 422 mm for stations located at and east of Calgary. The mean annual temperature for the foothills stations ranges from 1.5 to 2.5°C while for stations east of Calgary, it varies between 2.8 and 3.6°C. While the difference in mean annual temperature is not great from east to west, examination of the data presented in table 4 reveals that the mean summer temperature, the frost-free period, and the solar heat input as expressed in degree days above 5°C are all substantially lower at the foothills stations than at the eastern locations. At all stations, July is the warmest month, with a mean temperature of from 13.4° to 16.6°C; January is the coldest month, with a mean temperature of −10.0 to −12.7°C. The major portion of precipitation at all stations occurs during the May to September growing season (60 to 72 percent of total). In general, the climate is cooler and more humid in the western portions of the map area than it is to the east.

### Climatic variability

Superimposed on the regional climatic zonation are numerous microclimates resulting from local variations in aspect, drainage and topography. Slopes with north- and east-facing aspects in the foothills and uplands receive less radiation and experience relatively cool, moist microclimates. They generally are forested, while the warmer and drier south- and west-facing slopes are grass covered. Cool moist microclimates develop in local depressions due to the accumulation of groundwater, surface runoff and cold air drainage. These topographic lows are subject to more frequent frosts and reduced growing season heat input than are

**Table 4.** Climatic data for selected stations within or adjacent to the study area.*

| Station | Latitude | Longitude | Elevation (m) | No. years reporting | Temperature (°C) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mean ann. max. | Mean ann. min. | Mean ann. temp. | July mean | Jan. mean |
| Crossfield | 51°25′N | 114°10′W | 1130 | 9 (1971-1979) | 8.7 | -3.1 | 2.9 | 15.1 | -11.3 |
| Blackie North | 50°46′N | 113°46′W | 1070 | 5 (1972-1977) | 9.7 | -3.0 | 3.4 | -10.1 | |
| Bragg Creek | 50°57′N | 114°38′W | 1370 | 2(1975-1977) | 10.9 | -4.6 | 3.1 | 14.5 | - 7.4 |
| Calgary Glenmore Dam | 51°01′N | 114°06′W | 1070 | 18 (1959-1977) | 9.5 | -2.8 | 3.3 | 16.4 | -11.0 |
| Calgary Int. Airport | 51°07′N | 114°01′W | 1080 | 94 (1881-1977) | 10.2 | -3.0 | 3.6 | 16.5 | -10.6 |
| Chestermere Lake South | 51°02′N | 113°47′W | 1020 | 6 (1974-1979) | 9.4 | -4.2 | 2.6 | 16.3 | -12.9 |
| Cochrane | 51°13′N | 114°26′W | 1280 | 19 (1961-1979) | - | - | - | - | - |
| High River | 50°30′N | 114°09′W | 1200 | 69 (1902-1977) | 10.5 | -4.0 | 3.3 | 15.6 | - 9.7 |
| Millarville | 50°47′N | 114°31′W | 1400 | 8 (1971-1979) | 8.7 | -6.0 | 1.2 | 12.9 | -11.4 |
| Okotoks | 50°43′N | 113°59′W | 1050 | 19 (1913-1932) | 9.3 | -2.7 | 3.3 | 15.9 | - 9.9 |
| Priddis | 50°53′N | 114°31′W | 1370 | 3 (1972-1975) | 9.1 | -3.1 | -2.5 | 14.4 | - 8.6 |
| Calgary U of C | 51°05′N | 114°08′W | 1110 | 14 (1964-1977) | 9.4 | -2.7 | 3.4 | 16.0 | -11.9 |
| Ghost Ranger Station | 51°19′N | 114°47′W | 1550 | 16 (1962-1977) | 9.2 | -4.2 | 2.5 | 13.4 | -11.7 |

*Compiled by the Agrometeorological Section, Agriculture Canada, from Environment Canada, Atmospheric Environment Service records.

**Table 4.** (continued)

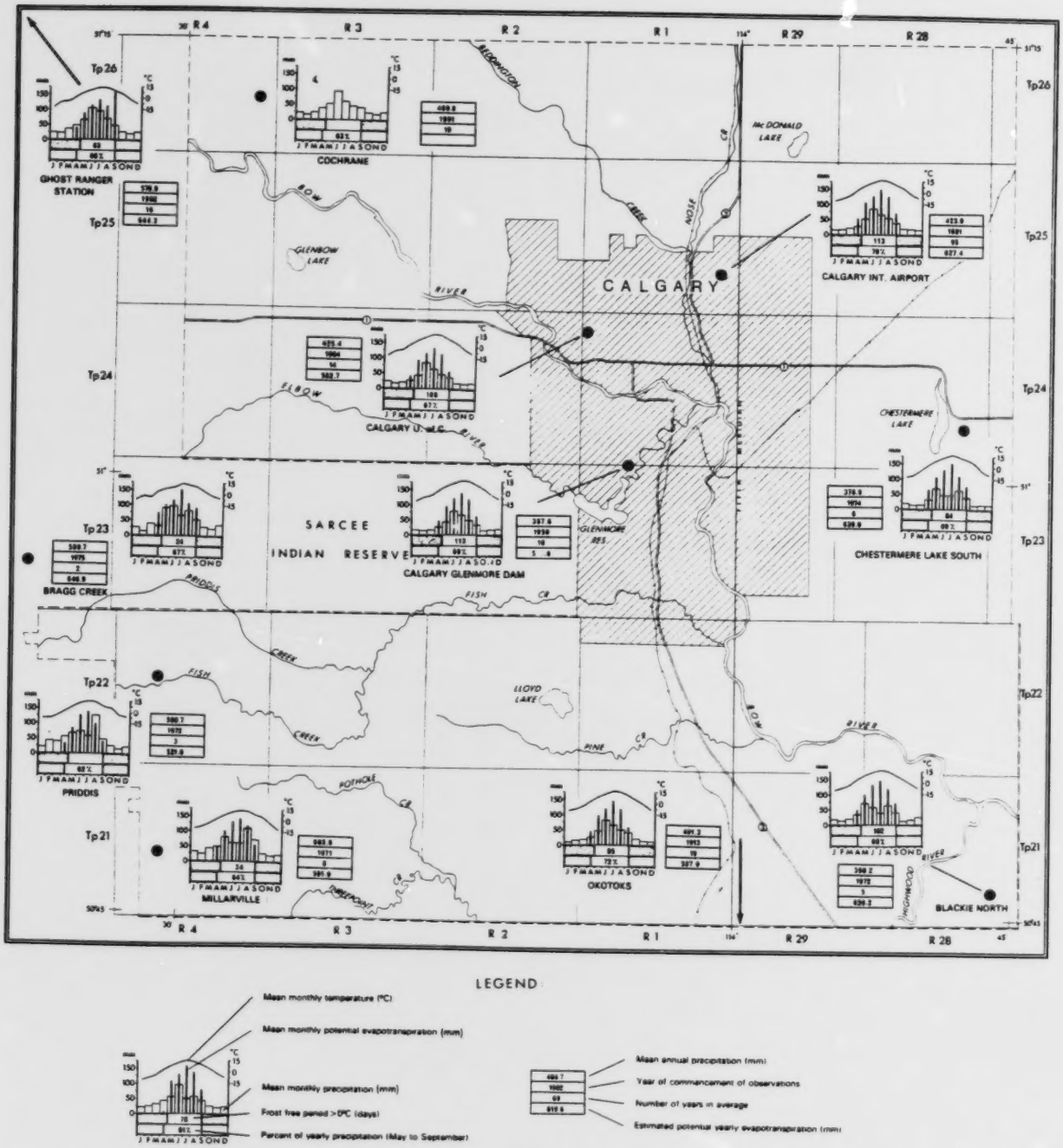
| | Precipitation (mm) | | Potential evapotranspiration (mm) | Frost-free Period | | Growing season degree days above 5°C for period |
|---|---|---|---|---|---|---|
| | Mean ann. | % May to September | | >0°C | > −2°C | >0°C |
| Crossfield | 505 | 71% | 671 | 84 | 137 | 1160 |
| Blackie North | 398 | 68% | 620 | 102 | 142 | 1243 |
| Bragg Creek | 590 | 67% | 647 | 24 | 76 | 846 |
| Calgary Glenmore Dam | 388 | 69% | 584 | 113 | 140 | 1280 |
| Calgary Int. Airport | 423 | 70% | 627 | 113 | 144 | 1281 |
| Chestermere Lake South | 370 | 69% | 639 | 84 | 119 | 1203 |
| Cochrane | 470 | 63% | - | - | - | - |
| High River | 487 | 61% | 620 | 78 | 112 | 1110 |
| Millarville | 604 | 64% | 596 | 34 | 82 | 748 |
| Okotoks | 401 | 72% | 587 | 85 | - | 1171 |
| Priddis | 590 | 62% | 522 | - | - | 945 |
| Calgary U of C | 425 | 67% | 563 | 108 | 142 | 1246 |
| Ghost Ranger Station | 579 | 66% | 644 | 63 | 113 | 855 |

the associated upland portions of the landscape. This condition is particularly noted in the narrow valleys of the foothills and in the rough areas of hummocky topography. The effect of Chinook winds on climatic variability within the area is more difficult to determine. The influence of Chinooks, however, can be seen in the extension of a warmer, drier microclimate up the Bow Valley west from Calgary, and in the moderation of winter temperatures throughout the area.

**Climate and land use**

Under the Canada Land Inventory, Capability for Agriculture Classification System, assessment of soils for agricultural potential is strongly dependent on the climatic conditions that exist where the soil is found. In Alberta, a generalized Agroclimatic Map has been produced, based on the amount and distribution of precipitation, the length of the growing season as defined by frost-free period, and the quantity of heat units available for plant growth (defined as degree days above 5°C). This map, and the Agroclimatic Zones defined for it, are used as guidelines in assigning the soils mapped in the Calgary area to particular agroclimates. Figure 11 shows the generalized distribution of agroclimates within the Calgary area. This distribution was derived by combining the available meteorological data with information volunteered by long-time residents, observations of land use patterns, and computer simulation of climate for locations where data were lacking. Changes in climate are gradual and never as abrupt as these delineations indicate. In practice, sharp breaks in climate are rarely recognized. What occurs on the map is an interfingering of soils characteristic of one climatic zone with those of another. Where these zones overlap, soils defined as occurring predominantly within one climatic zone may obviously be subject to the prevalent conditions of the adjacent zone.

The Calgary area contains many of the climatic zones that have been defined for Alberta. This is mainly due to the rapid decrease in the frost-free period west of Calgary. That short frost-free period is related




LEGEND


Mean monthly temperature (°C)
Mean monthly potential evapotranspiration (mm)
Mean monthly precipitation (mm)
Frost free period >0°C (days)
Percent of yearly precipitation (May to September)
Mean annual precipitation (mm)
Year of commencement of observations
Number of years in average
Estimated potential yearly evapotranspiration (mm)

**Figure 10.** Locations and graphical summary of data for climate stations within or bordering the Calgary urban perimeter survey area.

to the rise in elevation going west from Calgary, the effects of cold air drainage from the mountains, and locally higher topography in areas that are close to the mountains.

## Vegetation

Because it is so strongly influenced by climate, the pattern of vegetation in the Calgary area closely parallels the described climatic zonation. In regions where temperatures during the growing season are moderate and evapotranspiration exceeds precipitation, the natural vegetation is predominantly grass. Where temperatures during the growing season are cool and moisture loss by evaporation is low, the natural vegetation is predominantly forest.

The area has been divided by Rowe (1959) into the Boreal Forest Region and the Grassland Region (figure 12). The Boreal Forest Region is further sub-

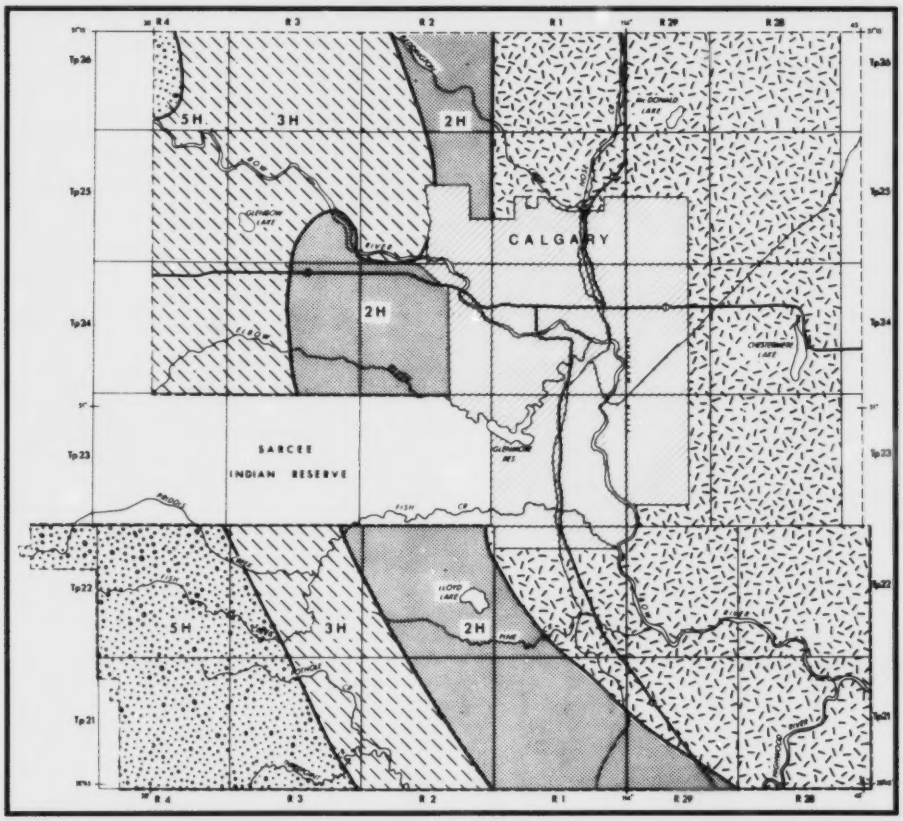



**Figure 11.** Generalized distribution of agroclimatic zones within the Calgary urban perimeter survey area.

divided into the Aspen Grove section and the Upper and Lower Foothills sections. Associated with the foothills sections, are isolated areas classified by Rowe as the Subalpine Forest Region—East Slope Rockies section and the Mountain Forest Region—Douglas Fir Lodgepole Pine Section. The grassland region outlined by Rowe is described as mixed prairie grassland in Soils of Canada (Clayton et al., 1977).

The vegetation of the map area is discussed according to the previously outlined physiographic subdivisions (figure 4). The relationship between vegetation zones and physiographic subdivisions is outlined in table 5.

## Vegetation regions

*Foothills subdivision*

The Rocky Mountain foothills consist of a series of parallel razorback ridges that are forested to their summits. Within the map area, the forest is dominantly mixed white spruce *(Picea glauca)* and aspen poplar *(Populus tremuloides)* with some balsam poplar *(Populus balsamifera)* and the occasional lodgepole pine *(Pinus contorta)* and douglas fir *(Pseudotsuga manziesii)*. The understory is complex, but usually consists of various combinations of buffaloberry *(Shepherdia canadensis)*, wolf willow *(Elaeagnus commutata)*, willow *(Salix spp.)*, green alder *(Alnus crispa)*, prickly rose *(Rosa acicularis)*, gooseberry *(Ribes spp.)*, raspberry *(Rubus pubescens)*, wild strawberry *(Fragaria virginiana)*, wild vetch *(Vicia americana)*, northern bedstraw *(Galium boreale)*, sticky purple geranium *(Geranium viscossisimum)*, bearberry *(Arctostaphylos uva-ursi)*, smooth fleabane *(Erigeron glabellus var. pubescens)*, common plantain *(Plantago major)*, dandelion *(Taraxacum officinale)*, violet *(Viola* spp.), common yarrow *(Achillea millefolium)*, fireweed *(Epilobium angustifolium)*, paintbrush *(Castilleja spp.)*,

**Table 5.** Relationship between vegetation zones and physiographic subdivisions within the Calgary urban perimeter survey area.

| Vegetation zone | Physiographic subdivision |
|---|---|
| **Grassland Region** | |
| Mixed Prairie Grassland | Delacour Plain |
| | Bow Valley |
| **Boreal Forest Region** | |
| Aspen Grove section | Calgary Laking Basin |
| | Okotoks Benchland |
| | Leighton Centre Upland |
| | Big Hill and Broadcast Hill Uplands |
| Upper and Lower Foothills section | Rocky Mountain foothills |
| | Priddis Valley |
| | Elbow Valley |

bunchberry *(Cornus canadensis)*, dogwood *(Cornus stolonifera)*, grasses and some mosses under the denser stands of white spruce.

Lodgepole pine is the dominant tree species in two areas. It predominates over a large flat area of fine-textured soils between Fish Butte and Priddis Creek estates. Also, on some of the higher ridges, the forest becomes more open above about 1370 m; lodgepole pine becomes the dominant tree there, and the understory is largely composed of grasses (plate 13).

*Priddis Valley subdivision*

The Priddis Valley is transitional to the Aspen Grove section of the Boreal Forest Region. The climate, and hence the vegetation, are considerably affected by frost and moisture in this low-lying to depressional landscape. Much of the land has been cleared for pasture, where the vegetation consists of introduced grasses, shrubby cinquefoil *(Potentilla fruticosa)*, rough cinquefoil *(Potentilla norwegica)*, pasture sage *(Artemisia frigida)*, sagebrush *(Artemisia cana)*, threeflowered avens *(Geum triflorum)*, some scrub willow and swamp birch *(Betula pumila var. glandulifera)* and scattered aspen, balsam poplar and white spruce. Where clearing has not taken place, the most common lowland vegetation consists of scrub willow and swamp birch, which grow to 2 m in height, and a thick understory of grasses, shrubby cinquefoil *(Potentilla fruticosa)*, rough cinquefoils *(Potentilla norwegica)*, strawberry, meadow rue *(Thalictrum spp.)*, common yarrow, northern bedstraw, wild vetch and fireweed. Scattered patches of open forest dominated by aspen poplar and willow, but also including alder, balsam poplar, white spruce, black spruce *(Picea mariana)* and wolf willow, occur in association with the more common shrub vegetation. Upland portions of the landscape are generally open pasture on the south- and west-facing hillsides and aspen forest on the north-and east-facing slopes.

*Leighton Centre Upland subdivision*

The vegetation of the Leighton Centre Upland is typical of the Aspen Grove section of the Boreal Forest Region. It consists of roughly equal parts of fescue grassland and aspen forest. The dominant grasses are rough fescue (*Festuca scabrella* Torr.), wheat grass (*Agropyron* spp.), porcupine grass (*Stipa spartea*, Trin.), blue grama grass (*Bouteloua* spp.) and June grass (*Koeleria enstata*). The wheatgrass, porcupine and blue grama grasses are more common on drier south-facing hillsides. Occurring with the grasses are wolf willow, pasture sage, buffaloberry, rough and shrubby cinquefoil, lupine *(Lupinus* spp.), puccoon *(Lithospermum* spp.), prairie onion *(Allium textile)* and Saskatoon *(Amelanchier alnifolia)*. In the more shaded, forested areas, aspen poplar dominates, with lesser

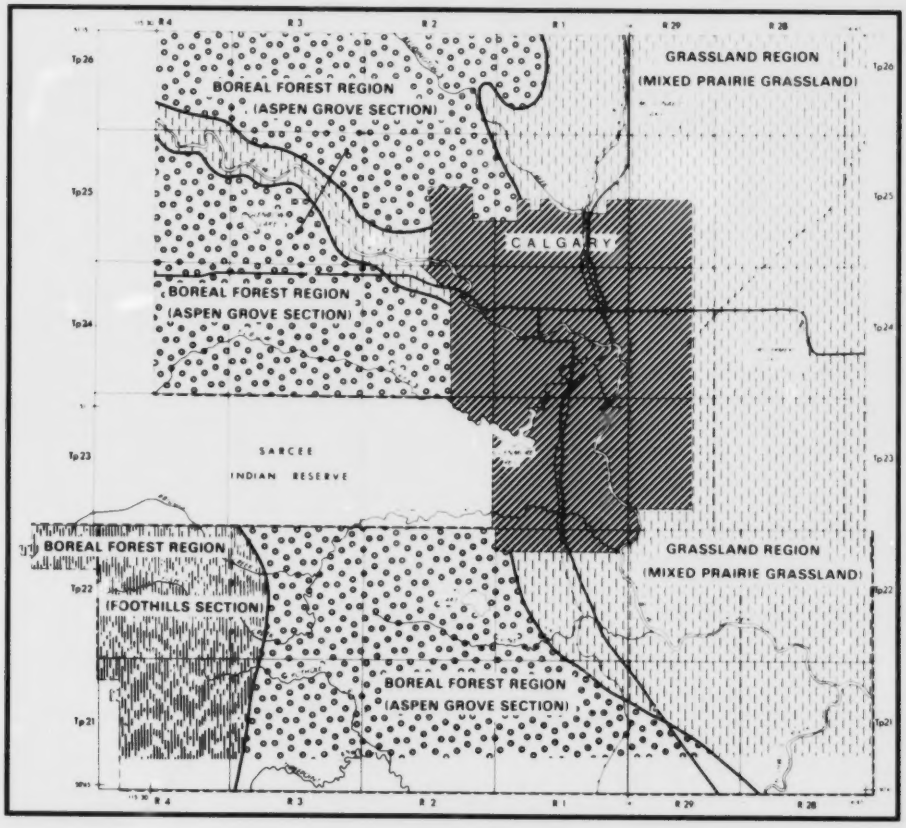



**Figure 12.** Generalized vegetation zones of the Calgary urban perimeter survey area.

**Plate 13.** Foothills Valley vegetation

amounts of balsam poplar, willow, alder, white spruce and saskatoon. The understory is generally fairly open and consists of various combinations of dogwood, gooseberry, rose, raspberry, paintbrush, fireweed, geranium, vetch, lupine, nettle *(Utrica* spp.), cow parsnip *(Heracleum lanatum)*, clematis *(Virginis* spp.), Solomon's seal *(Mianthemum canadense)*, meadow rue, violet, strawberry, colombine *(Aquilegia* spp.), grasses and some mosses.

*Calgary Laking Basin subdivision*
In the Calgary Laking Basin, much of the land is cultivated, and groves of aspen are less frequent than on the adjacent uplands. Forested areas are generally confined to north and east slopes associated with isolated flat-topped bedrock highs which rise from the plain, or to gullies and river valleys cut below the plain. The description of the aspen grove vegetation is similar to that given in the preceding sections, while the dominant native grasses remain rough fescue, blue grama, porcupine grass and wheatgrass. Most of the land is cleared for the production of coarse grains or the grazing of livestock.

*Big Hill and Broadcast Hill Uplands subdivision*
The Big Hill and Broadcast Hill Uplands are roughly similar to the Leighton Centre upland previously described. They contain about equal amounts of open forest and fescue grassland or cultivated land. On the Big Hill Upland, the aspen forest is concentrated in areas of hummocky moraine due to changes in climate, hydrology and land use associated with the rough topography.

*Okotoks Benchland subdivision*
The native vegetation of the Okotoks Benchland has been considerably altered by clearing and cultivation. At present, this area is predominantly cultivated or in improved pasture and contains only scattered groves of aspen poplar and willow. The forested areas occur mainly on north and east facing slopes, along stream channels and in coulees or gullies. The aspen grove vegetation is similar to that previously described. The dominant native grasses are rough fescue, blue grama, porcupine grass and wheatgrass.

*Elbow Valley and Bow Valley subdivisions*
The Elbow Valley between Calgary and Bragg Creek consists largely of a coniferous forest of white and black spruce, with considerable willow and some balsam and aspen poplar. The Bow Valley, by comparison, is very different in character, consisting almost entirely of grassland, with stands of aspen, white spruce and douglas fir restricted to the north-facing slopes of the valley. The dominant grass species are blue grama, porcupine grass, spear grass *(Sponotolus comata)* and rough fescue, with June grass in more moist locations.

*Delacour Plain subdivision*
The Delacour Plain is almost exclusively grassland, with trees restricted to moist and protected areas such as hollows, coulees and riverbanks. The native grasses are spear grass, blue grama grass and June grass. Saskatoon, rough and shrubby cinquefoils, prairie sage *(Artemisia ludoviciana)* and pasture sage, buffalo bean *(Astragalus crassicarpus)*, puccoon and lupine are scattered throughout the grassland area. Overgrazing often leads to increases in the proportion of cinquefoil in a pasture. Most of the soils of this area are cultivated to wheat *(Triticum* spp.), barley *(Hordeum* spp.), rye *(Secale* spp.), flax *(Linum usitatissimum)*, canola (rapeseed) *(Brassica napus)* or oats *(Avena* spp.), with much of the grain and forage used for beef production.

# Part II - Soil survey concepts and procedures

A soil survey has three principal objectives. The first is to determine what kinds of soils occur in a given geographic area. The second is to produce a map which subdivides the whole area into smaller units which contain less-variable amounts of the different recognized soils. The third is to interpret the likely significance of these units to all purposes relevant to the survey.

In order to accomplish these objectives, a soil surveyor must have an understanding of the processes of soil formation and the factors that control them in the particular study area. This understanding is used to classify the soil to make it easier to remember soil characteristics and interrelationships. Classification is useful for organizing and applying the results of experience and research, and for exchanging information about the soils among pedologists. Finally, soil surveyors use their understanding of soil genesis and classification systems to systematically subdivide the landscape.

## Soil genesis

In this section, the processes of soil formation and the factors controlling them are described. Soils possess chemical and physical characteristics that reflect the effects of the environment in which they form. The recognition of these characteristics depends on studies of the soil profile.

### The soil profile

A soil profile is a vertical cross-section of successive layers or horizons that extend from the surface downward into the unaltered parent material. Soil horizons differ from one another in one or more of the following features: color, texture, structure, consistence, reaction, thickness, and chemical and biological composition. Master soil horizons are designated L, F, H or O for organic horizons, and A, B, or C for mineral horizons. Lower case letter suffixes are used to indicate the type of horizon, and Arabic numeral suffixes are used when further division into subhorizons is required. The presence of lithologically non-conforming parent materials is shown by the use of Roman numeral prefixes. Master horizon designations and lower case suffixes are defined in table 6. A diagrammatic example of the use of these is given in figure 13.

### The processes of soil formation

Soil is a dynamic, organized, natural body on the earth's surface, which contains living matter and which supports, or is capable of supporting, plants. Soils are formed through complex, continuing processes that can be grouped into four general categories: addition, removal, transfer, and transformation (Simonson, 1959).

In the Calgary area, the accumulation of organic matter in the surface layers of mineral soils is an example of the process of addition. The organic residue is mainly responsible for the dark color of these surface layers.

The loss of lime from the upper 50 to 100 cm of many of the soils in the Calgary area is an example of the removal process. Initially, these soils were carbonated to the surface, but the lime has been leached from the upper part of the profile by water moving through the soil.

Water is also the carrier for most of the transfers which occur in the formation of soils in this area. In some of the soils, clay has been transferred from the A horizon to the B horizon. Thus, the A horizon becomes a zone of eluviation, or loss. The B horizon is a zone of illuviation, or gain. Not all transfers are in a downward direction. Water moving upward due to evaporation at the surface may bring soluble salts from lower horizons along with it. These salts remain at or near the surface after the water evaporates and have, in effect, been transferred from a lower to an upper horizon. Lateral transfers may also occur when water moves in a horizontal direction.

Examples of transformation include the weathering of clay minerals within soil profiles and the oxidation of iron compounds, which imparts the reddish color to the slightly altered Bm horizons that are common throughout the area.

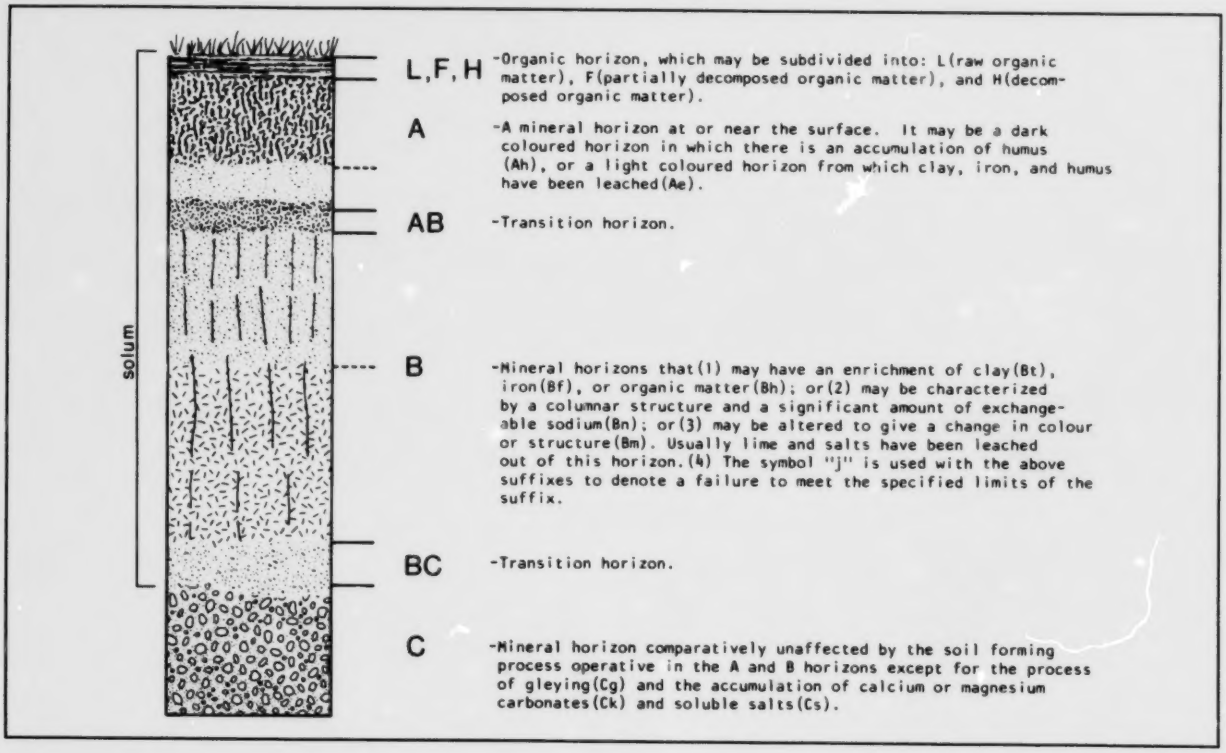

solum
L,F,H
-Organic horizon, which may be subdivided into: L(raw organic matter), F(partially decomposed organic matter), and H(decomposed organic matter).
A
-A mineral horizon at or near the surface. It may be a dark coloured horizon in which there is an accumulation of humus (Ah), or a light coloured horizon from which clay, iron, and humus have been leached(Ae).
AB
-Transition horizon.
B
-Mineral horizons that(1) may have an enrichment of clay(Bt), iron(Bf), or organic matter(Bh); or(2) may be characterized by a columnar structure and a significant amount of exchangeable sodium(Bn); or(3) may be altered to give a change in colour or structure(Bm). Usually lime and salts have been leached out of this horizon.(4) The symbol "j" is used with the above suffixes to denote a failure to meet the specified limits of the suffix.
BC
-Transition horizon.
C
-Mineral horizon comparatively unaffected by the soil forming process operative in the A and B horizons except for the process of gleying(Cg) and the accumulation of calcium or magnesium carbonates(Ck) and soluble salts(Cs).

**Figure 13.** Diagram of a soil profile showing various horizons.

**Table 6.** Definition of soil horizon symbols pertinent to the Calgary urban perimeter survey area (after Canada Soil Survey Committee, 1978).

Organic Horizons

Organic horizons are found at the surface of some mineral soils, or at any depth beneath the surface in buried soils, or overlying geologic deposits. Such horizons contain more than 17 percent organic carbon by weight. Two groups are recognized.

(1) O - This is an organic horizon developed mainly from mosses, rushes, and woody material.
   (a) Of - The fibric horizon is the least decomposed of all the organic soil materials. It contains large amounts of well-preserved fiber that is readily identifiable as to botanical origin.
   (b) Om - The mesic horizon is in an intermediate stage of decomposition, with intermediate amounts of fiber and moderate bulk density and water-holding capacity. The fiber is partly altered both physically and biochemically. A mesic horizon is one that fails to meet the requirements of either fibric or humic horizons.
   (c) Oh - The humic horizon contains the most highly decomposed organic soil materials. It has the least amount of fiber, the highest bulk density, and the lowest water-holding capacity. A humic horizon is very stable and changes very little physically or chemically with time, unless it is drained.

(2) L-F-H - These organic horizons develop primarily from leaves, twigs, woody materials, and a minor component of mosses.
   (a) L - This is an organic horizon characterized by an accumulation of organic matter in which the original structures are easily discernible.
   (b) F - This is an organic horizon characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The horizon may be partly comminuted by soil fauna, moder*, or it may be a partly decomposed mat permeated by fungal hyphae, mor.**
   (c) H - This is an organic horizon characterized by an accumulation of decomposed matter in which the original structures are indiscernible. This material differs from the F horizon by its greater humification, chiefly through the action of organisms. This horizon is a zoogenous humus form consisting mainly of spherical or cylindrical droppings of microarthropods. It is frequently intermixed with mineral grains, especially near the junction with a mineral horizon.

Master Mineral Horizons and Layers

Mineral horizons are those that contain less organic carbon (<17 percent) than is specified for organic horizons.

(1) A - This is a mineral horizon formed at or near the surface in the zone of removal of materials in solution or suspension or in the zone of maximum in situ accumulation of organic matter, or both. Included are:
   (a) horizons in which organic matter has accumulated as a result of biological activity (Ah);
   (b) horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of these (Ae).
   (c) horizons disturbed by man's activities such as cultivation, logging and habitation. (Ap, Op).

(2) B - This is a mineral horizon characterized by one or more of the following:
   (a) an enrichment in silicate clay (Bt);
   (b) an enrichment in sesquioxides (Bf);
   (c) an alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below (Bm and Bg);
   (d) a columnar structure and a significant amount of exchangeable sodium (Bn).

(3) C - This is a mineral horizon comparatively unaffected by the pedogenic processes operative in A and B, excepting the process of gleying (Cg) and the accumulation of calcium and/or magnesium carbonates (Ck) and more soluble salts (Cs) (Csa).

(4) R - This is a consolidated bedrock layer that is too hard to break with the hands (<3 on Moh's scale) or dig with a spade when moist, and that does not meet the requirements of a C horizon. The boundary between the R layer and any overlying unconsolidated material is called a lithic contact.

Lowercase Suffixes

(1) b - A buried soil horizon.
(2) ca - A horizon of secondary carbonate enrichment in which the concentration of lime exceeds that in the unenriched parent material.
(3) e - A horizon characterized by the removal of clay, iron, aluminum, or organic matter alone, or in combination. When dry, it is higher in color value by 1 or more units than an underlying b horizon. It is used with a (Ae, Ahe).
(4) f - A horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It usually has a hue of 7.5yr or redder, or its hue is 10yr near the upper boundary and becomes yellower with depth. It contains 0.6 percent or more pyrophosphate-extractable Al + Fe in textures finer than sand and 0.4 percent or more

**Table 6.** (continued)

in sands. The ratio of pyrophosphate-extractable Al + Fe to clay is more than 0.05 and organic carbon exceeds 0.5 percent. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. These criteria for "f" do not apply to Bgf horizons. A Bf horizon contains 0.5 to 5 percent organic carbon. A Bhf horizon contains more than 5 percent organic carbon.

(5) g - A horizon characterized by gray colors, or prominent mottling, or both, indicating permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less.

(6) h - A horizon enriched with organic matter. When used with A it must show one munsell unit of value darker than the horizon below, or have 0.5 percent more organic carbon than the parent material (IC). It contains less than 17 percent organic carbon by weight.

(7) j - Used as a modifier of suffixes e, f, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies. It must be placed to the right and adjacent to the suffix it modifies.

(8) k - Denotes the presence of carbonate as indicated by visible effervescence when dilute HC1 is added.

(9) m - A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in color or structure, or both.

(10) n - A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. When used with B it must also have the following properties: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistency when dry.

(11) p - A layer disturbed by man's activities, such as cultivation, logging and habitation.

(12) s - A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface crusts of salt crystals, by depressed crop growth, or by the presence of salt-tolerant plants. It is commonly used with C and k (Csk).

(13) sa - A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates, in which the concentration of salts exceeds that present in the unenriched parent material. The conductivity of the saturation extract must be at least 4 ms/cm and must exceed that of the C horizon by at least one-third. The horizon is 10 cm or more thick.

(14) t - An illuvial horizon enriched with silicate clay. It is used with B alone (Bt), with B and g (Btg), with B and n (Bnt), and so on.

(15) Bt - A Bt horizon is one that contains illuvial layer-lattice clays. It forms below an eluvial horizon, but may lie at the surface of a soil that has been partially truncated. It usually has a higher ratio of fine clay to total clay than the IC. It has the following properties:

(a) If any part of an eluvial horizon remains and there is no lithologic discontinuity between it and the Bt horizon, the Bt horizon contains more total and fine clay than the eluvial horizon, as follows:

(i) If any part of the eluvial horizon has less than 15 percent total clay in the fine earth fraction, the Bt horizon must contain at least 3 percent more clay.

(ii) If the eluvial horizon has more than 15 percent and less than 40 percent total clay in the fine earth fraction, the ratio of clay in the Bt horizon to that in the eluvial horizon must be 1.2 or more.

(iii) If the eluvial horizon has more than 40 percent total clay in the fine earth fraction, the Bt horizon must contain at least 8 percent more clay than the eluvial horizon.

*Moder - plant material in a state intermediate between living and decayed
**Mor - a raw type of humus developed under cool, moist conditions

The four soil-forming processes have affected all soils in the Calgary area, but to varying degrees. For example, the accumulation of organic matter and the removal of lime are the predominant processes in the formation of the dark-colored grassland soils of the area. In the light-colored, forested soils found in the foothills, the downward transfer of clay and colloidal material has been the dominant process.

## The factors of soil formation

The manner and the intensity in which soil-forming processes combine to produce the soils recognized in the Calgary area is determined by the controls exerted by the factors of soil formation (Dokuchaev, 1889). For the sake of convenience, these factors can be grouped into five general categories: parent material, climate, living organisms, relief and time. Theoretically, if all of these factors are identical at different sites, soils at these sites would also be identical. Variations among soils are caused by variations in one or more of these factors.

### *Parent material*

Parent material is the raw material from which soils are formed. It imparts to the soil that develops from it, certain characteristics that are critical to the performance and use of the soil. The most obvious inherited property is soil texture. In the Calgary area, weathering of soil components is not intense, and the texture of most soils is similar to that of their parent materials. Texture, in turn, affects many important soil characterisitics, such as water-holding capacity, rate of water movement through the profile (permeability), workability, nuturient-holding capacity, and usefulness as an engineering material. There are many less-obvious contributions of the parent material to the eventual properties of the soil. The mineralogical composition of the parent material can affect the type and abundance of mineral nutrients available for plant growth; the compactness of the material can affect rates of water movement and profile development; and the calcareousness of the original material can profoundly influence the rates of profile development, and the

reaction and buffering capacity of the resultant soil. Most of the parent materials found in the Calgary area were deposited from glacier ice or from bodies of glacial meltwater during the Pleistocene Epoch.

*Climate*

Climate has a profound influence on soil formation. It is a source of matter and energy for soil formation and acts directly on soil development (Macyk, 1972). It displays a direct influence through such factors as temperature and precipitation. Generally, weathering proceeds most rapidly in warm, moist environments and is slower where conditions are cool and dry. Thus, in comparison to tropical areas, the soils in the vicinity of Calgary are only weakly weathered. In a less direct fashion, climate determines the type of vegetation under which a soil develops.

Many of the processes of soil formation are related to leaching by downward infiltration of water through the profile. This movement depends on the amount of precipitation received and the net amount remaining after losses from evaporation and runoff. Thus, locally, soils in cool, moist environments will experience the greatest amount of leaching.

Other soil forming processes are directly linked to soil or air temperature. These include mineral weathering, decay of organic residues, freezing and thawing, and upward water movement due to surface evaporation.

*Living organisms (plants and animals)*

The vegetation under which a soil forms is also an active factor in controlling soil formation. It affects the color, structure, reaction and organic matter content of the soil. Soils that formed under forests are generally lighter in color than those formed under grasslands, because grass is more effective than trees in returning organic matter to the soil.

Bacteria, fungi and many other micro-organisms aid in the breakdown and return of plant residue to the soil. The kind of organic residue that is returned to the soil depends, to some extent, on the kind of organism involved in the breakdown. Generally, fungi are most active in acid soils, and bacteria in alkali soils.

Earthworms, burrowing insects and other small animals constantly mix the soils. Their burrows help to make the soil porous and permit passage of water. They may contribute to the development of structure with their mixing. They play an active role in breaking down and incorporating organic debris into the soil. Earthworm activity is noted throughout the Calgary area, even in the dark gray, forested soils found in the foothills.

Man is a late comer as an influence in soil formation, although his influence on soils will be even greater in the future. Accelerated erosion caused by cultivation and clearing is one example of man's influence. Cultivation also affects soil's structure and tends to lower the content of organic matter. Drainage of wet soils, clearing of forested soils and deep ploughing of Solonetzic soils have a marked effect on their subsequent development. The addition of fertilizers, lime or other amendments change, to some degree, the chemical composition of the soil.

*Relief*

For this discussion, relief includes topographic position, and slope orientation, shape and intensity. Relief affects soil formation mainly by influencing the redistribution of matter and energy over the earth's surface. Changes in elevation give rise to changes in the climatic parameters of temperature and moisture regime. Similar variations may arise from differences in slope orientation or aspect. Relief also influences the amount of runoff and the depth to the groundwater table. In general, steeper soils are more rapidly drained than nearly level soils. They are also more likely to be affected by water erosion caused by rapid runoff.

Topographic position determines whether a site will receive or contribute to surface runoff. It also plays a large part in determining the nature of the groundwater regime, which will affect a site. There is a strong, but frequently overlooked, relationship between groundwater regimes and the soils that form at the ground surface. In recharge areas, the dominant direction of groundwater movement is downward. Under forests, strong downward leaching of clay-sized material results in the formation of eluviated profiles. In grassland areas, clay movement is not prominent, but soluble salts and carbonates are removed from the upper part of the soil. Poorly drained soils form in depressions which accumulate surface runoff and non-saline groundwater that has travelled laterally only short distances. Slow downward infiltration of this water may lead to strongly leached soils. Topographic position may place a soil in a location that receives discharge of saline groundwater (Toth, 1963). This groundwater is associated with intermediate or regional groundwater flow systems. In travelling large distances and penetrating to considerable depth, it develops a high concentration of total dissolved solids. Sodium and sulfate ions are more abundant than calcium and bicarbonate in the water. The direction of groundwater movement is predominantly horizontal or upward. Soils in well-drained landscape positions may be affected in varying degrees by groundwater discharge. Some show only minor accumulations of soluble salts in their lower horizons. In some areas, saline groundwater has infused the soil to the surface with soluble salts over a period of time. Where this has been followed by a lowering of the water table and the initiation of net downward leaching, Solonetzic soils have formed. Where the water table has remained high, the poorly drained soils have weakly expressed horizons and are saline Rego Humic Gleysols.

*Time*

The nature and intensity of horizon development undergone by a soil profile is, among other things, a function of the length of time that soil forming processes have acted upon the original parent material. All parent materials in the Calgary area are of Pleistocene age or younger. This means that, in geologic terms (figure 14), the time frame for soil development has been relatively short (about 10 000 years). Some soils are even younger, as a result of recent deposition of fresh parent geologic material or by erosion and exposure of underlying strata. These

**Geologic Time scale:**

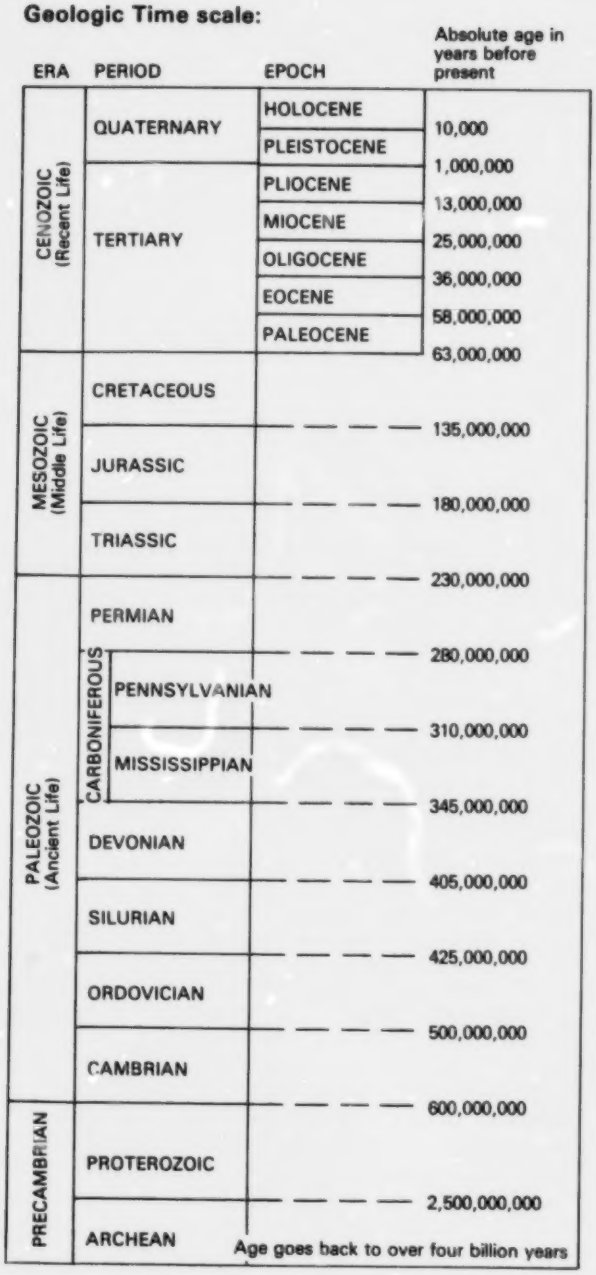



**Figure 14.** Geologic time scale.

younger soils are found mainly in stream channels that have received recent sedimentation or on colluvial hillsides where erosion and downslope movement continually replenish the parent material at a site.

## Soil classification

Soil classification consists of an orderly grouping of soils according to a rational and explicitly defined system. The overall aim of soil classification is to organize the knowledge of soils in a reasonable and useful way. In Canada, soils are classified according to the Canadian System of Soil Classification (Canada Soil Survey Committee, 1978). This is a natural or taxonomic system in which the classes are based on properties of the soils themselves and not on interpretations of the soils for various uses. This system is hierarchal in structure and has five levels, or categories. They are, from the broadest to the most specific: the order, the great group, the subgroup, the family and the series. Although the taxonomy of the Canadian system is defined on the basis of soil properties, the system has a genetic bias, in that, properties that reflect genesis are favored as differentia in the higher categories.

Table 7 shows the classification of each soil series mapped in the Calgary area by order and subgroup. The equivalent classification of each series according to the United States Soil Taxonomy System can be found in appendix A. Soils belonging to seven of the nine orders defined for the Canadian system have been mapped in the study area. Following is a brief description of these soil orders.

**Table 7.** Key to the classification of soil series mapped in the Calgary urban perimeter survey area.

| Order | Subgroup | Series name | Symbol |
|---|---|---|---|
| Brunisolic | Eluviated Eutric Brunisol | Bragg Creek | BRG |
| Chernozemic | Orthic Black | Academy | ADY |
| | | Antler | ATL |
| | | Bow Valley | BOV |
| | | Delacour | DEL |
| | | Dunvargan | DVG |
| | | Fish Creek | FSH |
| | | Lloyd Lake | LLK |
| | | Mesa Butte | MSB |
| | | Midnapore | MDP |
| | | Rockyview | RKV |
| | | Sarcee | SRC |
| | | Spy Hill | SPY |
| | | Strathcona | SCO |
| | | Tweedsmuir | TWS |
| | Rego Black | Bearspaw | BPW |
| | | Eastbow | EBO |
| | | Happy Valley | HPV |
| | | Highwood | HIW |
| | | Nose Creek | NSK |
| | Orthic Dark Gray | Sundre | SUD |
| Gleysolic | Orthic Humic Gleysol | Pothole Creek | POT |
| | Rego Humic Gleysol | Balzac | BZC |
| | | DeWinton | DWT |
| | Humic Luvic Gleysol | Indus | IND |
| Luvisolic | Orthic Gray Luvisol | Connop | CON |
| | | Spruce Ridge | SPR |
| | Dark Gray Luvisol | Elbow | ELB |
| | | Leighton Centre | LTC |
| | | Robinson | RSN |
| Organic | Terric Mesisol | Unnamed | TM |
| Regosolic | Gleyed Humic Regosol | Twin Bridges | TBR |
| Solonetzic | Black Solodized Solonetz | Beddington | BED |

**Brunisolic soils**
The Brunisolic order consists of rapidly to imperfectly drained soils that have developed under forest, mixed forest and grass, or heath and tundra vegetation. They are distinguished from Luvisolic and Podzodic soils by their lack of subsurface horizons of clay (Bt) or iron (Bf) accumulation, respectively. In the map area, they have organic (L-H) surface horizons, thin to absent organo-mineral (Ah) horizons and weakly to strongly developed eluvial (Ae) horizons. They are found mainly on steep slopes where soil creep has disrupted the formation of textural B horizons and on coarse-textured parent materials, which lack sufficient clay to develop illuvial horizons.

**Chernozemic soils**
The Chernozemic order consists of well to imperfectly drained soils that have developed under grassland or grassland/forest plant communities. They are characterized by a dark-colored surface horizon, at least 10 cm thick, that results from the accumulation of organic debris from the decomposition of xerophytic and mesophytic grasses and forbes. They do not have solonetzic or podzolic subsurface horizons, are not strongly gleyed and lack permafrost within 2 m of the surface.

Chernozemic soils occupy most of the Calgary map area. They range from deep and well-developed with surface horizons in excess of 20 cm thick to thin and poorly developed with surface horizons barely 10 cm thick. Some have weak eluvial (Ae) horizons, some have no horizon differentiation below the surface and others have weak concentrations of soluble salts in their subsoils. They are classified as Eluviated Blacks or Dark Grays, Rego Blacks and Solonetzic Blacks, respectively.

**Gleysolic soils**
The Gleysolic order consists of poorly drained soils that have features indicative of periodic or prolonged waterlogging. They develop under various climatic and vegetative conditions in the presence of a high or fluctuating water table. These soils may have organic surface horizons up to 40 cm thick and are characterized throughout the profile by dull grayish colors that may be embellished by prominent yellowish or reddish mottles. All three great groups; the Humic Gleysol, the Gleysol and the Luvic Gleysol are present in the study area. Several subgroups were mapped. The Orthic Humic Gleysols have dark-colored mineral surface horizons (Ah) and slightly altered gleyed subsurface horizons (Bg). The Rego Humic Gleysols have a similar dark-colored surface but lack subsurface horizonation. They are often saline and carbonated to the surface. Humic Luvic Gleysols have dark-colored surfaces overlying horizons of leaching (Ae) and clay accumulation (Bt).

**Luvisolic soils**
The Luvisolic Order consists of well to imperfectly drained soils that have developed in cool climates under predominantly forest vegetation. They are characterized by light-colored eluvial (Ae) horizons and illuvial (Bt) horizons in which silicate clay has accumulated. In the map area, these soils have L-H surface horizons and thin or absent Ah horizons. Three subgroups of the Gray Luvisol great group are found in this area: Orthic Gray Luvisols, Dark Gray Luvisols and Brunisolic Gray Luvisols.

**Organic soils**
The Organic order consists of soils which contain 17 percent or more organic carbon and have developed in poorly to very poorly drained areas, primarily from peat deposits greater than 40 cm thick. In the map area, only a few small occurrences of Organic soils were encountered. These are classified mainly as Terric Mesisols. They consist of 40 to 160 cm of mesic fen peat developed from decomposed sedge vegetation overlying a mineral contact.

**Regosolic soils**
The Regosolic order consists of rapidly to imperfectly drained soils that are weakly developed and lack the horizon development required to be placed in any other order. Soils of both the Regosol and Humic Regosol great groups were encountered in the map area. Cumulic Regosols and Cumulic Humic Regosols were found on post-glacial floodplains of the major rivers and streams, and occasionally on steep slopes subject to soil creep. Orthic Regosols were recognized in undifferentiated gravel deposits within active drainage channels and in locations of severe erosion, but none were mapped as major components of soils units.

**Solonetzic soils**
The Solonetzic order consists of well to imperfectly drained soils that have been affected by high concentrations of sodium-saturated groundwater. They are characterized by subsurface (Bn or Bnt) horizons, which are very hard when dry and which swell to a sticky mass of low permeability when wet. Typically, the solonetzic B horizon has a prismatic or columnar macrostructure that breaks to hard blocky peds with dark coatings. It is defined as having a ratio of exchangeable Ca to Na of 10 or less. Small areas of Solonetzic soils were encountered during this project. Only one series, a Black Solodized Solonetz was defined and mapped.

## Soil mapping

In this section, the scientific basis of soil mapping is examined, the actual field procedures carried out in the course of data collection are described and problems associated with the mapping of the Calgary area are discussed. Included also are explanatory notes that will help the reader to use the soil map and the accompanying legend.

**Scientific basis of soil mapping**
The object of preparing a soil map is to record and transmit information about soil features at, or near, the earth's surface. For this to be successful, both the user and the mapper must possess an adequate understan-

ding of the principals upon which soil mapping is founded and the limitations inherent in the procedure.

The scientific basis of soil survey is that the locations of soils on the landscape have a degree of predictability. This predictability is based on the surveyor's understanding of how the factors of soil formation combine to control the genesis of soils on given landscapes. Using this knowledge, the surveyor constructs a working model of soil-landscape associations, which he then tests by making field observations at selected points on the landscape. The purpose of making these observations is not to obtain a number of random samples from which conclusions will be drawn to make a map when subjected to statistical techniques. It is to either confirm or reject the surveyor's hypothesis of what soil is expected on a given landscape unit. Since soil is a continuum and adjacent soils seldom have sharp boundaries, he must be satisfied with defining soil-landscape units that contain a restricted range of soils and soil properties.

A soil surveyor is not able to investigate all points within every landscape delineation. In fact, more than 99 percent of the soil delineated in making a soil map is not observed below the surface (Miller et al., 1979). Obviously then, information obtained from single point observations must be extrapolated to refer to large areas. Boundaries are drawn and descriptions of the delineated areas are made, based on the inference that the areas between samples were properly characterized by the samples taken.

It is important that users understand the significance of inference and extrapolation in making soil maps. Information contained in soil unit descriptions is not site specific for each point within every soil unit delineation. Efforts to use this information as site specific for small areas can cause substantial problems.

**Field procedures and mapping conventions**

Field work in the Calgary urban perimeter survey area began in the spring of 1977. Preliminary field and office investigations were carried out to determine the nature of the various soils likely to be encountered in the area and their relationships to observable landscape features. Landscape units were then outlined on 1974 panchromatic (black and white) aerial photographs at a scale of approximately 1:31 680. At the end of each field season, the separations which had been verified in the field were compiled, checked and transferred to 1:50 000 National Topographic System (NTS) base maps. The final result was the preparation of four separate soil maps, published at a scale of 1:50 000.

The major portion of the Calgary urban perimeter survey area is cultivated or being developed for country residential or industrial purposes. As a consequence, a regular road allowance grid with 1.6 km spacings in north-south roads, and 1.6 and 3.2 km spacings on east-west roads, provided adequate vehicle access over most of the study area. Portions of the foothills area southwest of Calgary had limited road access, and soil investigations were made by traversing cutlines on foot. With the exception of the foothills area, the only limitations to access were from intense country residential development in some areas and, occasionally, from land owners who denied access to their land. On average, between six and ten soil observations were recorded within, or bordering, each section of land in the study area. That corresponds to a Level 3 survey intensity level, as defined in *A proposed Soil Mapping System for Canada* (Expert Committee on Soil Survey, 1979). At that level, most traverses were by vehicle, and some on foot. Some boundaries and almost all delineations were checked in the field.

The soil encountered at each inspection site was classified and given a soil series name, if applicable. This involved recording the arrangement, thickness, color, texture, consistency and structure of the observed soil profile horizons. Other factors considered were the origin and properties of the parent material, the topography at the site and within the unit as a whole, the vegetation, soil drainage, stoniness, erosion and slope. Representative samples of the various soil series recognized in this study were collected for laboratory analysis.

Since access was more or less uniform over the entire study area, the reliability of the soils information contained on the maps should be similar throughout the area. The following section discusses efforts taken to determine the reliability and variability of several of the major soil units defined for this study.

**Reliability and variability of soil units**

Every soil map contains discrepancies in the form of delineations that differ from the general description of the soil unit in which they are included. These unavoidable discrepancies are inherent in the technique employed in making soil surveys; namely, creating models of soil-landscape associations. Miller et al. (1979) point out that some error is unavoidable because (1) the predictive value of landscapes is not perfect, (2) the sampling intensity is inadequate to verify the presence of all soil bodies that may exist, and (3) the sampling tends to be biased toward the most prominent soils and landscape features.

This soil survey is expected to receive wide usage to assess the suitability of soil areas for a broad range of agricultural, engineering, environmental and recreational uses. This anticipated use produces a requirement for a quantitative evaluation of the accuracy and dependability of the soil units identified for this survey. The problem of testing soil unit composition and variability was recognized early in the survey, and a search for a recognized testing procedure was initiated. It was decided that, at the conclusion of the project, the maximum practical number of major soil units would be sampled using the random transect method described by Steers and Hajek (1979) and Arnold (1979).

*Testing soil unit composition by the random transect method*

Fourteen of the most extensive soil units defined for the soil survey were subjected to sampling by the random transect method. Transects were conducted on about five separate, randomly selected delineations of each of these soil units. Observations and samples

were taken along the transects at a fixed interval of 125 m. After the samples were analyzed, the data were evaluated to determine the composition of the tested soil units in terms of their soil series components and the variability of properties important for interpretations within each of the units. By obtaining estimates of the variability of the soils components, it is possible to say, for example, that with 90 percent confidence, soil A makes up 60 to 80 percent of the area of soil unit X. The results of this evaluation are presented in table 8. The range of values of selected soil characteristics for both the tested soil units and the major recognized soil series contained with these soil units are presented in Appendix C.

The soil component analyses of the tested soil units were compared to the original estimates of soil unit composition as prepared for the working legend. The results indicated that some units had limited variability and that the original field estimates of soil unit composition were within the range of values determined by the transect method. Not surprisingly, these units were located on landscapes which had a high predictive value. That is, the shape and character of the land-

**Table 8.** Statistical evaluations, using ANOVA (Arnold, 1979), of Calgary urban perimeter survey area soil units.

| | | | Computed confidence intervals (90%) | |
|---|---|---|---|---|
| **Soil unit** | **Soil name** | **Soil symbol** | **Percent composition** | **Comments** |
| RKAD 1 | Rockyview<br>Academy<br>Eastbow | RKV<br>ADY<br>EBO | 36-60%<br>18-40%<br>5-10% | Unit designation was changed to RKAD 1 to reflect predominance of Rockyview soil. |
| ALT 1 | Antler | ATL | 79-96% | ATL 1 unit was found to consist almost entirely of Antler series. No other soil unit showed such high compositional purity. |
| DEL 1 | Delacour<br>Rockyview | DEL<br>RKV | 62-85%<br>7-25% | Presence of thin loess veneer and associated Rockyview soils was noted during transect evaluation. |
| DVG 1 | Dunvargan<br>Unnamed clayey soils | DVG | 30-60%<br>22-55% | Testing revealed high proportion of clayey intergrades between Dunvargan and Fish Creek. |
| FSH 1 | Fish Creek | FSH | 65-86% | Unit was found to contain a uniform composition of Fish Creek soil. |
| FSH 2 | Fish Creek<br>Pothole Creek gleyed soils<br>eluviated soils | FSH<br>POT | 24-50%<br>15-35%<br>14-20%<br>10-15% | Unit was found to contain mixture of well and poorly drained clayey soils as originally described. |
| FSH 3 | Fish Creek Unnamed till subsoil variants | | 30-65%<br>28-62% | Presence of till subsoil variants in this unit was confirmed during transect evaluation. |
| LLK 1 | Lloyd Lake<br>Bearspaw<br>Unnamed similar soils | LLK<br>BPW | 30-54%<br>18-40%<br>8-28% | Testing revealed higher proportion of weakly developed and calcareous soils than originally estimated. |

**Table 8.** (continued)

| Soil unit | Soil name | Soil symbol | Percent composition | Comments |
|---|---|---|---|---|
| LTC 1 | Dark Gray Luvisol (Leighton Centre)<br>Orthic Gray Luvisol<br>Lithic soils | LTC<br>- | 15-40%<br>10-30%<br>14-38% | Unit was found to contain slightly more Dark Gray Luvisols than Orthic Gray Luvisols. |
| ELRS 1 | Elbow and similar soils<br>Robinson and similar soils<br>Orthic Gray Luvisols on clayey LG or till<br>Spruce Ridge<br>Pothole Creek | ELB<br>RSN<br><br>SPR<br>POT | 10-40%<br>6-28% | Testing of RSN 1 and ELB 1 units revealed both to be virtually indistinguishable from one another due to considerable variability in composition. A new combined unit ELRS 1 was created to describe the mixture of soils. |
| SPR 1 | Spruce Ridge shallow and lithic soils | SPR | 39-65%<br>12-32% | Testing confirmed original description of unit as Spruce Ridge with shallow and lithic soils. |
| SPY 1 | Spy Hill Gleysols and gleyed soils | SPY | 48-75%<br>10-30% | Testing confirmed original description of unit as Spy Hill soil with limited poorly drained soils. |
| SRC 1 | Sarcee<br>Unnamed well-drained soils<br>Unnamed gleyed soils | SRC | 25-55%<br>10-40% | Testing revealed high variability of alluvial soil properties but confirmed Sarcee as dominent soil series. |
| SRC 2 | Sarcee<br>Unnamed similar well-drained soils<br>Unnamed dissimilar well-drained soils<br>Unnamed Gleysols and gleyed soils | SRC | 5-20%<br>23-48%<br>14-38%<br>23-48% | Testing revealed that the fluvial soils of SRC 2 unit fell into several classes in the Taxonomic System due to their high degree of variability |

scape conveyed to the surveyor much of the information needed in order to effectively outline and describe them. Other tested units were found to depart considerably from the concept initially used to describe the unit.

Some of these units were located on landscapes that had an inherently low predictive capacity. The landscape told the mapper little regarding the nature of the soils contained within it and neither the time nor the resources were available to conduct a more detailed investigation. A few units simply had an extremely high inherent variability. For example, SRC 2 was mapped on recent fluvial floodplains and, as expected, displayed a wide variety of soil drainage conditions and considerable variation in parent material texture. This variability was taken into account in the original field estimates but they underestimated the range of soils and soil properties actually contained in the unit. Table 8 indicates the degree of correspondence of the original estimates to the evaluated soil unit compositions. Appendix C contains comments regarding the extent and nature of the soil property variability determined for the tested soil units.

**Comparison with the ecological land classification system**

A comparison (table 9) of the mapping system used in this survey and the most recent version of the levels of ecological generalization proposed by the Canada Committee on Ecological (Bio-Physical) Land Classification (Wilken, 1979) indicates the similarities between the two approaches. The basic descriptive element of this survey is the soil unit. It is comparable to the Ecosite as defined in table 9. The soil unit consists of a series or an assemblage of series found on a particular landform or repeating pattern of landforms. It includes all separations made at higher levels in the system. As such, any given soil unit is completely placed within a defined climate zone and physiographic division and occurs only on a single parent geologic material or a narrow range of parent materials.

**Explanatory notes on the soil map and legend**

In this section is an explanation of the various categories and terms used in the legend and soil unit descriptions that accompany the soil map. It serves as a guide to the procedures governing soil unit definitions that were used during the course of this survey. Soil terminology not explained in this section is defined in appendix E.

*Soil group* - A soil group is a group of closely interrelated soil series developed on similar parent materials under similar climates (for example, Dunvargan - DVG).

In this survey, all units dominated by a single soil series are placed into a soil group named after that series. This implies that all soil units included within that soil group are located within the same agroclimatic zone and that all have the same dominant parent material. The broad soil groups are subdivided into soil units, which, while dominantly composed of the naming series, have substantially different combinations of included soils, drainage conditions or surface form. Soil groups are strictly a mapping convenience used to bring together various collections of soils to focus on certain pertinent aspects of the landscape.

**Table 9.** Comparison of mapping system approaches and terminology.

| Ecological land classification | | | This study | |
|---|---|---|---|---|
| **Generalization** | **Criteria** | **Scale of mapping** | **Level of classification** | **Criteria** |
| 1. Ecoregion (Land Region) | Macro- and mesaclimate vegetation regions regional landforms soil great group assemblages | 1:1 000 000 to 1:3 000 000 | 1. Physiographic regions | Physiography and general climate |
| 2. Ecodistrict (Land District) | Meso- and microclimate plant districts regional landforms soil subgroup assemblages | 1:500 000 to 1:125 000 | 2. Physiographic Divisions | Subdivisions of Level 1 based on detailed climate inferences and general soil patterns |
| 3. Ecosection (Land System) | Microclimate plant association local landform assemblages soil family assemblages | 1:250 000 to 1:50 000 | 3. Soil groups | Subdivisions of Level 2 based on soil parent material soil profiles and associated landforms |
| 4. Ecosite (Land Type) | Microclimate plant association or seral stage local landform or part of landform soil series or series complex | 1:50 000 to 1:10 000 | 4. Soil units | Subdivisions of Level 3 based on unique combinations of soil series on distinct local landforms |
| 5. Ecoelement | Small-scale microclimate parts of a plant association portion of a local landform phases of soil series | 1:10 000 to 1: 2 500 | 5. No equivalent | |

*Soil group combinations* - Soil group combinations are assemblages of closely related soil series developed under similar climates, but containing significant amounts of two or more dissimilar parent materials.

In this survey, some areas were encountered, that contained complex mixtures of soils and parent materials that were impossible to separate at this scale of mapping. Those areas contained two or more parent materials of contrasting origin and properties. They were assigned not to one group but to a combination of two groups named after the two contrasting soil series which dominated the soil unit. By convention, units defined for these combinations of soil groups were given four-letter symbols which are readily distinguishable from the three-letter symbols used for units belonging to simple soil groups.

*Soil unit* - Soil units are subdivisions of soil groups such that within a given soil unit; the component soil series are found in specified proportions.

In this survey, soil units are conceptual models of unique combinations of soil components, surface form and drainage conditions. They are based on the observation that relationships exist between observable landscape features and the soils that occur on those landscapes. Similar soil-landscape segments are outlined and placed within a named soil unit. The sum of all individual soil-landscape delineations placed into a single soil unit forms the basis for the description generated for that unit. Soil units are not real bodies of soil; they are generalized descriptions of what may be expected to be found within any given soil-landscape delineation assigned to that unit.

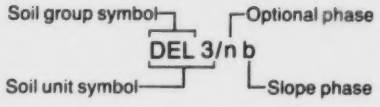
*Soil series* - This is the basic unit of soil classification in the Canadian System of Soil Classification and consists of soils that are essentially alike in all major profile characteristics except the texture of the surface (Agriculture Canada, 1976).

In this survey, soil series were identified for all different soils covering extensive areas. These series were given names taken from geographic features in the area where the soil was first identified or described. Some soil series included in this map area have been named and described in previous mapping projects in nearby areas.

*Soil phase* - A soil phase is a functional unit outside the system of soil taxonomy that may be designed to suit the purpose of any survey. It is a subdivision of any taxonomic class based on any soil characteristics that are considered to be significant to man's use or management of the land. Five soil phase notations are used in this survey. They are described in the Introduction of Part III of this report.

**Soil map notations**

Each individual soil area is shown on the map enclosed in a boundary line. The soil area within each boundary is identified by a unique collection of symbols. A typical identifying symbol from the map is illustrated and its various component parts explained in the following example:




# Part III - Descriptions of the soil groups and soil units

In this section, the soils of the Calgary urban perimeter are described. A general description of the soil series that is used to name each soil group is given. This is followed by short descriptions of the soil units recognized within each soil group. Unless otherwise mentioned, it is to be assumed that what is stated about the soil group holds true for any soil unit within that group. Thus, to get full information about any one soil unit, it is necessary to read the description of that unit and of the soil group to which it belongs.

An important part of the soil group documentation is the description of the soil profile. This is outlined briefly and in general terms in the soil group descriptions. More detailed and technically precise descriptions, along with corresponding analytical and interpretive data for each soil series, can be found in appendix A. This information is provided for soil scientists, engineers and others who need to make technical studies of the soil.

Following each soil group description are the descriptions of the individual soil units, as identified by the unique alphanumeric symbols which appear on the map. These symbols consist of three or four alphabetic characters followed by a single arabic numeral. The three-letter symbols are used for units that are composed predominantly of a single parent material, while the four-letter symbols are used for units that consist of two or more strongly contrasting parent materials. The Arabic numerals separate units of the same group that have different assemblages of soil series or occur on substantially different landforms.

The lower case letters following the main soil unit symbols on the map are phase modifiers and have the same meaning wherever they are found. Consequently, the various phases of each soil unit are not described separately in the following text. The most common phase modifiers pertain to the topographic slope class of the outlined area. These slope classes are identified by the letters a to i, inclusive, and are defined in the glossary. Five additional soil phases have been used in this project and they are defined below.

1. Gleyed phase (/g) - used for a few small areas where, due to a high water table, the soils of the mapped soil unit were slightly mottled. The areas were otherwise very similar to the described soil unit, and it was not considered worthwhile to define and describe a separate unit.

2. Buried gravel phase (/gv) - used for a number of occurrences of SPY, DEL and ATL soil units in which gravel was not encountered within the 1 m control section, but was believed or observed to exist at

greater depth. The presence of this gravel affects several land-use interpretations, most noticeably that of suitability as a source of gravel.

3. Lithic phase (/l) - used for areas where bedrock was observed to occur within 1 m of the surface in units otherwise defined as being not expected to have bedrock within the control section.
4. Saline phase (/n) - used for a number of well to poorly drained units in which patches of surface salts (sodium sulfate) were observed to cover more than 15 percent of the area of the delineations.
5. Peaty phase (/p) - used in areas where Gleysolic soils have greater than 15 but less than 40 cm of surface peat.

## Key to the soils of the Calgary urban perimeter

Table 10 is provided to assist users to locate particular facts about specific soil units. It shows the area in hectares and the proportionate extent of each soil unit and indicates on which pages of the report the user can find the description, agricultural interpretations, non-agricultural interpretations and detailed data forms pertaining to any given soil unit.

## Academy (ADY)

Academy is a deep, well-drained, black grassland soil formed on till in agroclimatic zone 1. The parent material is fine silty to fine loamy, strongly calcareous Laurentide till. The till is generally from 2 to 10 m thick, and is often associated with silty aeolian or sandy glaciofluvial deposits. The landforms range from undulating to ridged.

The natural vegetation associated with this soil is mixed prairie grassland. The main grasses are fescue, porcupine grass, spear grass, blue grasses (*Poa* spp.), June grass and blue grama grass. Presently, most areas are cultivated or seeded to improved pasture, except where slopes exceed 15 percent. Academy is mapped primarily within agroclimatic zone 1, where precipitation averages 400 mm per year and the frost-free period is usually greater than 90 days.

A representative profile of Academy soil has a relatively thin, black, loamy surface horizon (13 to 16 cm) underlain by a brown oxidized horizon. The unaltered parent material is encountered between 40 and 70 cm depth. The surface horizons are neutral to moderately alkaline and the subsurface is moderately to strongly alkaline. Academy is well drained, moderately pervious and has adequate moisture retention. Most rainfall enters the soil through infiltration, but medium surface runoff may occur on steep slopes and during heavy rains.

Academy is classified as an Orthic Black Chernozemic soil. Included with the areas mapped as Academy are similar soils classified as Rego Blacks or Solonetzic Blacks.

**ADHP 1**

This unit is found on nearly level to gently rolling morainal landscapes that are partially covered by a thin sandy to coarse loamy veneer. About 40 percent of the unit is Academy soil and 30 percent is Happy Valley soil. About 20 percent consists of well to poorly developed soils developed on silty loess (Rockyview, Eastbow) and 10 percent is weakly developed Sharp Hill soil.

The soil in the top 1 to 2 m of this unit is highly variable in texture, but the underlying subsoil is a fairly uniform fine loamy till. Till forms the main parent material for most soils in the unit, but there are extensive areas of sandy to silty soils. Profiles vary from weakly to strongly expressed.

The sandy portions of ADHP 1 areas have slight limitations for agriculture due to droughtiness and erosion. Rough topography may limit use of some areas that have steeper slopes. Non-farm uses may be limited by rapid permeability and high silt content over portions of the unit.

ADHP 1 areas are cultivated to wheat, barley and canola, or left in pasture. The glaciofluvial veneer is too thin and silty to provide a good source of gravel.

**ADHP 2**

This unit is found in areas of ridged topography with gentle to moderate slopes. Most of the ridges are till, but some are sandy to coarse loamy glaciofluvial deposits. Till predominates at the surface over most of the area, but there are scattered patches of sandy to silty glaciofluvial material overlying the till and there are deep glaciofluvial ridges. Poorly drained soils are common in the depressions between ridges. About 30 percent of the unit is Academy soil and another 30 percent is weakly developed, sandy to coarse loamy Happy Valley soil. Poorly drained, clayey DeWinton soil makes up about 20 percent of the unit, and the remainder consists of well to poorly developed silty soils (Rockyview, Eastbow).

The top meter of this unit may be fine loamy till, coarse loamy to sandy glaciofluvial or silty aeolian deposits. Most of the unit below 1 to 2 m is fine loamy till, but there are occasional ridges of sandy to coarse loamy glaciofluvial material that are several meters thick. Soil profiles range from well to weakly developed.

Agricultural use of parts of this unit may be limited by moderate slopes, droughtiness, erosion and soil wetness. Some engineering uses may be adversely affected by rapid permeability, high silt content, moderate slopes and erosion.

This unit is used about equally for pasture and cropland.

**ADHP 3**

This unit is mapped on moderately to steeply sloping ridges of mixed till and glaciofluvial sediments. About 20 to 40 percent of the unit is Academy soil and a similar amount is Happy Valley soil. The remainder of the unit is made up of various amounts of well to poorly developed silty soils (Rockyview, Eastbow); thin gravelly Strathcona soil, or eroded and thin Sharp Hill soil.

**Table 10.** Index to the location of soil unit information.

| Soil Group | Soil Unit | Area (ha) | % of Total Area | Page number in report: A Description | An Agricultural Interpretation | An Engineering Interpretation | A Soil Series Data Sheet |
|---|---|---|---|---|---|---|---|
| Academy | ADHP 1 | 1644 | 0.69 | 33 | 79 | 82 & 91 | 121 |
| | ADHP 2 | 108 | 0.04 | 33 | 79 | 82 & 91 | 121 |
| | ADHP 3 | 479 | 0.20 | 33 | 79 | 82 & 91 | 121 |
| Antler | ATL 1 | 15414 | 6.49 | 36 | 79 | 82 & 91 | 123 |
| | ATL 2 | 459 | 0.19 | 36 | 79 | 82 & 91 | 123 |
| | ATL 3 | 5202 | 2.19 | 37 | 79 | 82 & 91 | 123 |
| | ATL 5 | 2352 | 0.99 | 37 | 79 | 82 & 91 | 123 |
| Beddington | BED 1 | 205 | 0.08 | 39 | 79 | 82 & 91 | 129 |
| | BED 2 | 598 | 0.25 | 40 | 79 | 82 & 91 | 129 |
| | BED 3 | 1333 | 0.56 | 40 | 79 | 82 & 91 | 129 |
| Bow Valley | BOV 1 | 1794 | 0.75 | 41 | 79 | 82 & 91 | 131 |
| | BOV 2 | 129 | 0.05 | 41 | 79 | 82 & 92 | 131 |
| Bearspaw | BPW 1 | 1954 | 0.82 | 39 | 79 | 82 & 92 | 127 |
| Bragg Creek | BRG 1 | 58 | 0.02 | 41 | 79 | 82 & 92 | 133 |
| Balzac | BZC 1 | 2450 | 1.03 | 37 | 79 | 82 & 92 | 125 |
| | BZC 2 | 1814 | 0.76 | 38 | 79 | 83 & 92 | 125 |
| | BZC 3 | 1403 | 0.59 | 38 | 79 | 83 & 92 | 125 |
| | BZC 4 | 2664 | 1.12 | 38 | 79 | 83 & 92 | 125 |
| Connop | CON 1 | 57 | 0.02 | 42 | 79 | 83 & 92 | 135 |
| Delacour | DEL 1 | 34528 | 14.55 | 42 | 79 | 83 & 92 | 137 |
| | DEL 2 | 1896 | 0.79 | 43 | 79 | 83 & 92 | 137 |
| | DEL 3 | 1255 | 0.52 | 43 | 79 | 83 & 92 | 137 |
| | DEL 4 | 1023 | 0.43 | 44 | 79 | 83 & 92 | 137 |
| | DEL 5 | 1274 | 0.53 | 44 | 79 | 83 & 92 | 137 |
| | DEL 6 | 4056 | 1.70 | 44 | 79 | 83 & 92 | 137 |
| | DEL 7 | 2205 | 0.92 | 44 | 79 | 83 & 92 | 137 |
| | DEL 8 | 1128 | 0.47 | 45 | 79 | 83 & 92 | 137 |
| | DEL 9 | 608 | 0.25 | 45 | 79 | 83 & 92 | 137 |
| | DERK 1 | 5066 | 2.13 | 45 | 79 | 83 & 93 | 137 |
| | DERK 2 | 914 | 0.38 | 45 | 79 | 84 & 93 | 137 |
| Dunvargan | DVFS 1 | 1805 | 0.76 | 48 | 79 | 84 & 93 | 141 |
| | DVFS 2 | 371 | 0.15 | 49 | 79 | 84 & 93 | 141 |
| | DVG 1 | 12135 | 5.11 | 47 | 79 | 84 & 93 | 141 |
| | DVG 2 | 1628 | 0.68 | 47 | 79 | 84 & 93 | 141 |
| | DVG 3 | 13008 | 5.48 | 47 | 79 | 84 & 93 | 141 |
| | DVG 4 | 725 | 0.30 | 48 | 79 | 84 & 93 | 141 |
| DeWinton | DWHP 1 | 1046 | 0.44 | 46 | 79 | 84 & 93 | 139 |
| | DWT 1 | 973 | 0.41 | 46 | 79 | 84 & 93 | 139 |
| | DWT 2 | 179 | 0.07 | 46 | 79 | 84 & 94 | 139 |
| | DWT 3 | 179 | 0.07 | 46 | 79 | 84 & 94 | 139 |
| Eastbow | EBAD 1 | 994 | 0.41 | 49 | 79 | 84 & 94 | - |
| | EBAD 2 | 97 | 0.04 | 50 | 79 | 85 & 94 | - |
| Elbow-Robinson | ELRS 1 | 1521 | 0.64 | 51 | 79 | 85 & 94 | 145 |
| | ELRS 2 | 1180 | 0.49 | 51 | 79 | 85 & 94 | 145 |
| | ELRS 3 | 1399 | 0.58 | 51 | 79 | 85 & 94 | 145 |
| | ELRS 4 | 480 | 0.20 | 51 | 79 | 85 & 94 | 145 |
| Fish Creek | FSH 1 | 9401 | 3.96 | 52 | 79 | 85 & 94 | 147 |
| | FSH 2 | 2689 | 1.13 | 52 | 79 | 85 & 94 | 149 |
| | FSH 3 | 3350 | 1.41 | 53 | 79 | 85 & 94 | 149 |
| | FSH 4 | 323 | 0.13 | 53 | 79 | 85 & 95 | 149 |
| | FSH 5 | 572 | 0.24 | 53 | 79 | 85 & 95 | 149 |
| Highwood | HIBO 1 | 726 | 0.30 | 56 | 79 | 85 & 95 | - |
| | HIW 1 | 918 | 0.38 | 56 | 79 | 85 & 95 | - |
| Happy Valley | HPAD 1 | 565 | 0.23 | 54 | 79 | 86 & 95 | 151 |
| | HPAD 3 | 208 | 0.08 | 55 | 79 | 86 & 95 | 151 |
| | HPAD 4 | 253 | 0.10 | 55 | 79 | 86 & 95 | 151 |

**Table 10.** (continued)

| Soil Group | Soil Unit | Area (ha) | % of Total Area | Page number in report: A Description | An Agricultural Interpretation | An Engineering Interpretation | A Soil Series Data Sheet |
|---|---|---|---|---|---|---|---|
| | HPSC 1 | 264 | 0.11 | 55 | 80 | 86 & 95 | 153 |
| | HPV 1 | 964 | 0.40 | 55 | 80 | 86 & 95 | 151 |
| | HPV 2 | 612 | 0.25 | 55 | 80 | 86 & 95 | 151 |
| | HPV 3 | 388 | 0.16 | 56 | 80 | 86 & 95 | 151 |
| Indus | IND 1 | 157 | 0.06 | 57 | 80 | 86 & 95 | 155 |
| | IND 2 | 2393 | 1.00 | 57 | 80 | 86 & 96 | 155 |
| Lloyd Lake | LLK 1 | 8406 | 3.54 | 59 | 80 | 86 & 96 | 159 |
| | LLK 2 | 408 | 0.17 | 59 | 80 | 86 & 96 | 159 |
| | LLK 3 | 2618 | 1.10 | 59 | 80 | 86 & 96 | 159 |
| | LLK 4 | 1405 | 0.59 | 60 | 80 | 87 & 96 | 159 |
| Leighton Centre | LTC 1 | 4157 | 1.75 | 58 | 80 | 87 & 96 | 157 |
| | LTC 2 | 1487 | 0.62 | 58 | 80 | 87 & 96 | 157 |
| Midnapore | MD-L 1 | 251 | 0.10 | 63 | 80 | 87 & 96 | 163 |
| | MDAD 1 | 2684 | 1.13 | 62 | 80 | 87 & 96 | 165 |
| | MDP 1 | 796 | 0.33 | 62 | 80 | 87 & 96 | 163 |
| | MDP 2 | 684 | 0.28 | 62 | 80 | 87 & 96 | 163 |
| Mesa Butte | MSB 1 | 1338 | 0.56 | 61 | 80 | 87 & 96 | 167 |
| Nose Creek | NSK 1 | 730 | 0.30 | 63 | 80 | 87 & 96 | 169 |
| | NSK 2 | 874 | 0.36 | 63 | 80 | 87 & 97 | 169 |
| | NSK 3 | 196 | 0.08 | 64 | 80 | 87 & 97 | 169 |
| Pothole | POT 1 | 540 | 0.22 | 64 | 80 | 87 & 97 | 173 |
| | POT 2 | 1018 | 0.42 | 65 | 80 | 88 & 97 | 173 |
| | POT 3 | 1255 | 0.52 | 65 | 80 | 88 & 97 | 173 |
| Rough Broken | RB 1 | 2935 | 1.23 | 67 | 80 | 88 & 97 | 179 |
| | RB 2 | 1413 | 0.59 | 67 | 80 | 88 & 97 | 179 |
| | RB 4 | 3338 | 1.40 | 67 | 80 | 88 & 97 | 179 |
| | RB 5 | 1263 | 0.53 | 67 | 80 | 88 & 97 | 179 |
| Rockyview | RKAD 1 | 8806 | 3.71 | 65 | 80 | 88 & 97 | 175 |
| | RKAD 2 | 516 | 0.21 | 66 | 80 | 88 & 97 | 175 |
| | RKAD 3 | 1177 | 0.49 | 66 | 80 | 88 & 97 | 175 |
| | RKAD 4 | 666 | 0.28 | 66 | 80 | 88 & 98 | 175 |
| | RKAD 5 | 3310 | 1.39 | 66 | 80 | 88 & 98 | 175 |
| Strathcona | SCO 1 | 1115 | 0.47 | 71 | 80 | 89 & 98 | 183 |
| | SCO 2 | 508 | 0.21 | 71 | 80 | 89 & 98 | 183 |
| | SCO 3 | 216 | 0.09 | 71 | 80 | 89 & 98 | 183 |
| Spruce Ridge | SPR 1 | 8754 | 3.69 | 69 | 80 | 89 & 98 | 189 |
| | SPR 2 | 1219 | 0.51 | 69 | 80 | 89 & 98 | 189 |
| Spy Hill | SPY 1 | 4750 | 2.00 | 70 | 80 | 89 & 98 | 191 |
| | SPY 2 | 2179 | 0.91 | 71 | 80 | 90 & 99 | 191 |
| Sarcee | SRC 1 | 1500 | 0.63 | 68 | 80 | 90 & 99 | 193 |
| | SRC 2 | 1689 | 0.71 | 68 | 80 | 90 & 99 | 193 |
| | SRC 3 | 497 | 0.20 | 68 | 80 | 90 & 99 | 193 |
| | SRC 4 | 1574 | 0.66 | 68 | 80 | 90 & 99 | 193 |
| Sundre | SUD 1 | 492 | 0.20 | 72 | 80 | 90 & 99 | 195 |
| Twin Bridges | TBR 1 | 1640 | 0.69 | 73 | 80 | 90 & 99 | 199 |
| Terric Mesisol | TM 1 | 575 | 0.24 | 72 | 80 | 90 & 99 | - |
| Tweedsmuir | TWS 1 | 492 | 0.20 | 73 | 80 | 90 & 99 | 197 |
| | TWS 2 | 1413 | 0.59 | 73 | 80 | 90 & 99 | 197 |

This unit has a complex and variable mixture of parent materials. Some ridges are composed mainly of sandy to gravelly glaciofluvial sediments with only isolated inclusions of till. Other ridges are mostly till with lenses of glaciofluvial materials. All ridges have some sandy soils at the surface and scattered silty soils developed on loess. These ridges are thought to be eskers or fluted eskers, and are believed to have sandy glaciofluvial cores. Soil profile development is also variable. Steep slopes and rapid surface runoff contribute to the development of numerous thin, weakly developed or eroded profiles.

Agricultural use of this unit is limited mainly by steep slopes, droughtiness and erosion. Non-farm uses are affected by variable subsoil textures, rapid permeability, spots of high silt content soils, steepness of slope

and erosion. Most ADHP 3 areas are not cultivated and are used for pasture. A few ADHP 3 areas are, or have been, exploited as commercial sources of sand and gravel.

## Antler (ATL)

Antler is a deep, well-drained, black grassland soil formed on till in agroclimatic zone 2H. The till is fine loamy to fine silty in texture, contains about 5 to 10 percent coarse fragments at depth, is strongly calcareous and is of mixed Continental and Cordilleran origin. The Antler landscape is dominated by long, smooth, simple slopes. It is typically composed of rolling, till-blanketed, bedrock highs, surrounded by gently sloping ground moraine. It gives way at lower elevations to a level to undulating landscape, dominated by the separately mapped glaciolacustrine Lloyd Lake soils.

Most Antler soil areas are now cultivated. The original vegetation appears to have been characteristic of the forest/grassland transition zone. Fescue grassland predominates and groves of aspen poplar, alder and willow occur in protected areas on north- and east-facing slopes and in moist depressions. Antler is mapped primarily within agroclimatic zone 2H. Rainfall is generally adequate and averages 400 mm per year, but a slight frost hazard is present for slow-maturing grains. The frost-free period is estimated to be between 75 and 100 days. Antler soil is recognized by its thick, black surface horizon (Ah 15 to 30 cm) and bright, brown subsurface horizon (Bm), both of which contain few coarse fragments and may be partly aeolian in origin (plate 14). The till subsoil is whitish gray to buff and contains more stones than does the surface horizon (5 to 10 percent coarse fragments). The soil is well drained, moderately pervious and has adequate moisture retention. The long, smooth slopes on which this soil often forms contribute to moderate surface runoff. Grassed waterways are frequently maintained on the longer slopes to control erosion. Antler is classified as an Orthic Black Chernozemic soil.

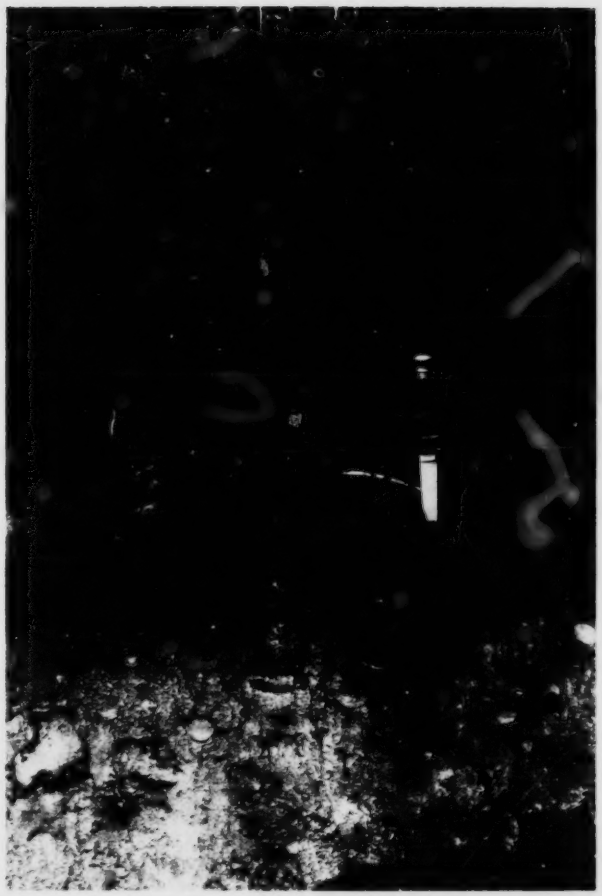


**Plate 14.** Antler soil profile

### ATL 1

ATL 1 units are mapped on gently undulating to gently rolling morainal topography. The land surface is usually smooth and slopes are often simple and uniform. ATL 1 consists almost entirely of Antler soil. It may contain minor amounts (15 percent) of Gleysolic or other contrasting soils but they are not of sufficient extent to affect any interpretations.

Soil properties appear uniform throughout this soil unit. As expected, some variability in the thickness of the surface horizon occurs. The soil is uniformly well drained and surface stoniness is slight. The soil texture is also uniform except along boundaries with other soils, particularly Lloyd Lake. Some overlap in soil properties is natural; such boundaries are often gradual.

The soils of this unit have few limitations to agricultural and engineering uses. The shortened frost-free period is a slight agricultural limitation, but, otherwise, soil properties are usually favorable. Most ATL 1 areas are cultivated. Barley and canola are the most frequently grown crops, followed by hay, oats, rye and wheat. Some ATL 1 areas are used for pasture.

### ATL 2

ATL 2 units are mapped on lower portions of the morainal landscape, where the water table frequently approaches the surface, and in areas of slightly hummocky topography, where the absence of an integrated drainage network results in a pock-marked pattern of poorly drained depressions. The unit consists mostly of Antler soil, but also includes substantial amounts (15 to 30 percent) of Gleysolic soils (DeWinton) which occur in wet depressional areas. Where occurrences of the wet soil areas are large enough, they are outlined separately (DWT). Where they are small individually, but collectively comprise a large percentage of an outlined area, the area is mapped as ATL 2.

A greater degree of variability in soil drainage conditions is associated with ATL 2 than with ATL 1. The ranges in profile depths and surface horizon thicknesses are also greater. Where ATL 2 units are located in lower portions of the landscape, there may be some occurrence of glaciolacustrine materials (Lloyd Lake soils) in the unit.

The wet soils (DeWinton) scattered throughout this unit are recognized to provide more severe constraints

to use than the remaining well-drained soils. They may disrupt cultivation or interfere with other potential uses of these areas (for example, road location), but they are not considered to seriously limit the usefulness of the well-drained soils. ATL 2 areas are frequently used for pasture or forage, but also may be cultivated to canola, barley or oats.

### ATL 3

This unit is mapped on moderately to strongly sloping till-covered hillsides. The slopes are almost always bedrock controlled, but the mantle of till overlying bedrock is consistently greater than 1 m thick. If bedrock occurs within 1 m of the surface over more than 15 percent of an outlined area of ATL 3, the phase symbol /1 is appended. ATL 3 consists principally of Antler soils (30 to 50 percent) but contains soils that are thinner, less-strongly developed, coarser and drier than most Antler soils.

The thickness and degree of development of soil profiles vary widely in this unit. Erosion removes material from upper slope positions and redeposits it in hollows and along toe slopes. Surface runoff occurs rapidly and is concentrated in narrow draws. Consequently, over most of the slope, there is little infiltration and storage of water, the soils are dry and often thinly developed. A major limitation to most uses of this unit is the steepness of the slopes associated with these landscapes. Low availability of soil moisture, and actual or potential erosion hazard, are additional limitations for agricultural use.

Some cultivation of the gentler slopes found in this unit occurs. The major cultivated crops are similar to those grown in ATL 1 units. Most areas mapped as ATL 3 remain in pasture.

### ATL 5

This unit is mapped on slightly rough, undulating, ridged or hummocky landscapes. The irregular topography results in more thin, weakly developed and eroded profiles than found on smoother topography. About 30 percent of the unit consists of Antler soil and about 30 percent is a similar, less-strongly developed soil. Up to 15 percent of the unit may be DeWinton or similar poorly to imperfectly drained soils. The rest of the unit consists of soils that are similar to Antler but which are eroded and have thinner surface horizons than in the Antler series.

This unit is uniformly composed of till. Depth and the degree of development of soil profiles are the main causes of variability within the unit. The minor, poorly drained depressions are not significant in interpreting this unit.

The 75- to 90-day frost-free period presents a slight limitation to agricultural use of this unit. Further slight limitations to agricultural use include rough topography and erosion. Some non-farm uses may also be limited by the rough topography.

ATL 5 areas are cultivated to barley, rye, canola, alfalfa, hay, and occasionally, wheat.

## Balzac (BZC)

Balzac is a wet, saline soil with a black surface horizon. It is formed on recent lacustrine sediments overlying till within agroclimatic zone 1. The lacustrine sediments are fine clayey in texture. They are strongly calcareous and have been salinized by groundwater discharge. Balzac soil occurs in level to depressional areas where recent lacustrine sediments have accumulated in hollows and in channels on the till landscape.

The salinity of this soil restricts the vegetation to salt-tolerant species. Foxtail barley, salt grass (*Distichlis stricta* Torr. Rydb.), alkali grass (*Puccinellia nuttalliana* Schult. Hitch.) and some of the wheat grasses are adapted to salinity and are the most common species encountered. Balzac soil occurs primarily in agroclimatic zone 1, but is also mapped in agroclimatic zone 2H.

Balzac soil has a black surface horizon of varying thickness and texture, and high organic matter content. This horizon is underlain by a firm, moist, fine-textured, dark-colored transitional horizon and then a light-colored weakly mottled subsoil. All horizons contain free lime and soluble salts, although the amounts are sometimes low in surface horizon. Balzac soil is poorly drained. It forms where saline groundwater is permanently maintained at or near the ground surface. It is associated with areas of groundwater discharge and a high water table. Ponding of water may persist on this soil for long periods after snowmelt or heavy rainfall (plate 15). Balzac is classified as a Rego Humic Gleysol, saline-carbonated phase.

### BZC 1

BZC 1 units are mapped on level to depressional landscapes that possess a veneer of recent lacustrine material overlying till. They occupy large, permanently wet, closed depressions or low-lying segments of drainages and glacial scour channels. BZC 1 areas consist almost entirely of Balzac soil. They may contain a few small areas (< 15 percent) of better-drained soils, mostly Delacour, which usually are located around the outside of the depressions.

Almost all the soils in BZC 1 units show evidence of

**Plate 15.** Balzac soil

wetness, and are clayey and sticky. The degree of salinity found at the surface can vary considerably between points within a given BZC 1 area and between similar BZC 1 areas. Some of this variability is noted at the phase level by the addition of the symbol n to the soil unit notation. Areas that display heavy accumulations of soluble salts over their entire surface are placed in a saline phase (/n) of BZC 1.

Wetness, high soluble salt content, high clay content and risk of flooding are factors that reduce the suitability of BZC 1 areas for most uses. Most BZC 1 areas do not respond well to cultivation, even when dry enough to support machinery. High salinity and adverse physical structure (hardpan) often severely limit crop growth in areas where cultivation has been attempted. If left undisturbed, the dependable moisture supply assures good yield of salt-tolerant native grass species. Buildings or roads are adversely affected by the wetness and salinity of BZC 1 soils. The depressions provide ideal conditions for construction of reservoirs, but the quality of the water that would collect in such areas would be poor. BZC 1 areas are almost always left in native pasture and are used for grazing or production of coarse hay.

**BZC 2**

BZC 2 areas occur in sinuous drainage channels in which Solonetzic soils have formed along the sides. There are several instances where sand has accumulated along the edges of these channels and Solonetzic soils have developed in this sand. BZC 2 areas are mostly wet Balzac soil (60 percent) with a component of better-drained, gleyed, sandy or Solonetzic soils.

BZC 2 areas are similar to BZC 1 areas except for the inclusion of a few hardpan-type soils (Beddington), which occur mostly along the edges of the mapped areas. Thus, most of the variability in the unit occurs along its edges and is related to the presence of sand and Solonetzic soils in this location.

Most of this unit offers the same restrictions to use as outlined in BZC 1 (wetness, salinity, high clay content, flooding hazard). The margins of the unit are better drained than the center areas but are affected by hardpan, and to some degree by wetness and flooding hazard. BCZ 2 areas are invariably left in pasture and used for grazing or production of coarse hay.

**BZC 3**

This unit is mapped on wet, nearly level to depressional areas of the morainal landscape. Better-drained soils (Delacour) are scattered throughout, wherever slight rises occur in the ground surface. About 70 percent of the unit consists of poorly drained Balzac soil, and the remainder is mostly better-drained Delacour soil.

BZC 3 is essentially the same as BZC 1. The only difference is that a small proportion of BZC 3 consists of better-drained Delacour soil and is interpreted accordingly.

Constraints to use are the same as for BZC 1, except for the portions of the unit which are better drained. These Delacour soils behave as DEL 1, except that their distribution within an area of wet soils reduces their usefulness for agriculture. This reduction arises from pattern limitations introduced by the surrounding wet soils. These areas are invariably left in rough pasture.

**BZC 4**

This unit consists of an irregular distribution of low knolls and depressions in low-lying portions of the till landscape where the water table is close to the surface. Recent lacustrine clay forms a veneer over the till in most of the depressions. BZC 4 areas contain variable proportions of wet saline Balzac soil (40 percent), deep, well-drained Delacour soil (30 percent) and hardpan-type Beddington soil (30 percent).

Soil conditions are highly variable within this soil unit. Much of the area is poorly drained, but well-drained soils may occur with changes in elevation of as little as 1 m. Soils with hardpans (Beddington) occur mostly in midslope positions, but their distribution is erratic and unpredictable. This unit is described as consisting of numerous small areas of very different soils, which are difficult to separate at this map scale.

Parts of BZC 4 areas are affected by one or more of the following limitations: wetness, salinity, hardpan, low permeability, high clay content and high plasticity. Use of the area as a whole is limited by the chaotic distribution of different soils within it. No single cultural practice applicable to any one of the soils found in this unit can be applied successfully to the entire area, so pattern becomes a limitation. Because of the difficulties arising from finding several soil types in one small area, these units are usually left in pasture and used for grazing or production of coarse hay.

## Bearspaw (BPW)

Bearspaw is a thin, weakly developed, black grassland soil formed on glaciolacustrine sediments in agroclimatic zone 2H. The sediments are fine silty to fine clayey in texture and from 3 to 20 m thick. They are characterized by a high content of silt-sized material and generally low sand content (< 10 percent). They are strongly calcareous, non to slightly stony, and are weakly bedded to massive.

Bearspaw soil is found on rough hummocky topography in the glaciolacustrine basins adjacent to the Bow Valley. Most areas of Bearspaw soil have been cultivated, and, consequently, the native vegetation of this unit is largely unknown. Rainfall is generally adequate and averages 400 mm per year, but a slight frost hazard exists for some grains. The frost-free period is estimated to be between 75 and 90 days.

A representative profile of Bearspaw soil has a thin, black to dark gray surface horizon, which often contains free lime. This is underlain by unaltered parent material or by calcareous material that shows evidence of some mechanical mixing, but otherwise differs little from the parent material. All horizons are moderately to strongly alkaline. Bearspaw is well drained, moderately pervious and has a medium moisture retention capacity. Rapid surface runoff from the rough

topography results in reduced infiltration of water into the soil and in topsoil erosion from upper slope positions.

Bearspaw is classified as a Rego Black Chernozemic soil. Some Orthic Black (Lloyd Lake) and Calcareous Black soils are included in this mapping unit.

**BPW 1**

This unit occurs on hummocky glaciolacustrine landscapes. The rough hummocky topography contributes to rapid surface runoff and erosion. This, in turn, leads to the formation of more thin, weakly developed or eroded profiles than on smoother glaciolacustrine landscapes (see LLK 1). Thin, weakly developed Bearspaw soil constitutes about 50 percent of this unit. Deep, well-developed Lloyd Lake soils form about 30 percent, and DeWinton or similar poorly to imperfectly drained soils occupy up to 15 percent of the unit. The remainder of the unit consists of thin or eroded profiles that do not match the definitions of Bearspaw or Lloyd Lake soils.

BPW 1 occurs on deep, uniform, fine silty glaciolacustrine deposits. The main variability in the unit arises from differences in the amount of erosion and the degree of profile development. Most soils are thin and poorly developed, but some are deep and well developed. These latter soils are usually found on lower slope positions and on gentler topography.

Limitations to agricultural use include the 75 to 90 day frost-free period, rough topography and erosion. Non-farm uses may be adversely affected by slope angles, erosion and the high silt and clay contents of the soil. Most BPW 1 areas are in pasture, but a few are cultivated to barley, canola or alfalfa.

## Beddington (BED)

This is a relatively shallow, thin, black grassland soil that has a strongly developed subsurface hardpan (Bnt). It occurs on till parent material in agroclimatic zone 1. The till is fine loamy in texture, contains generally less than 5 percent coarse fragments, is strongly calcareous and is predominantly of Continental origin.

Beddington soil occurs on level to gently undulating and gently rolling to inclined morainal landscapes. It develops in level, low-lying portions of the till landscape, where discharging saline groundwater occurs close to the soil surface, and on some inclined till slopes, where saline groundwater seeps from seams in the underlying bedrock. Where Beddington soil occurs in sufficiently large concentrations, it often remains unbroken and contains a grassland community quite representative of the original prairie vegetation of the region. Species that may occur include wheatgrasses, porcupine grass, spear grass, blue grama grass, June grass, blue grasses, alkali grass and salt grass. When the units contain saline gleysols, there is often a large component of salt-tolerant species, such as foxtail barley, included in the above described community.

Beddington soil occurs primarily within agroclimatic zone 1, but a few small areas have been mapped within agroclimatic zone 2H. This soil is easily recognized by the dense, compact hardpan (Bnt) horizon which forms at about 13 to 18 cm depth (plate 16). When dry, this horizon displays hard, dark-colored, round-topped columns which are often capped with white powdery mineral grains. When wet, this horizon becomes slippery and plastic and is often referred to as gumbo. The depth of topsoil overlying the hardpan is variable, but is usually less than 15 cm thick. Beddington soils are moderately well to imperfectly drained. They form where saline groundwater approaches the soil surface and often remain moist throughout most of the year. Due to the dense B horizon, surface water infiltrates the soil very slowly. This further increases the period of time over which these soils remain wet and can result in prolonged ponded conditions after snowmelt or heavy rains. Once dry, the hardpan restricts root penetration and upward water movement. Available soil moisture for plants is restricted to the overlying surface horizons (Ah, Ae) and may be rapidly removed during short periods of drought, resulting in reduced crop growth.

Beddington soil is classified as a thin Black Solodized Solonetz. A lot of variability accompanies the distribution of Solonetzic soils and, consequently, numerous soils may occur in areas mapped as Beddington even though they do not fit this classification. Of these, the most frequent inclusions of similar soils are thin Black Solonetz, Black Solods, and Gleyed Black Solonetz and Solodized Solonetz.

**BED 1**

BED 1 units are generally associated with upland portions of the morainal landscape on gently undulating or inclined topography. BED 1 areas consist mostly of Beddington and closely related Solonetzic soils (80 percent) along with a minor component of deep, well-drained Chernozemic soils (Delacour), which lack the solonetzic hardpan.

Solonetzic soils tend to occur in patches interspersed with other soils. For this reason, it is rare to find a large mappable area that is almost entirely Beddington soil. BED 1 is the most uniform of the Beddington units, but even so, considerable variability of soil properties is expected.

The adverse physical structure and water-holding characteristics of Beddington soil introduce several

**Plate 16.** Beddington soil

limitations for agricultural use. These soils are slow to dry out in the spring, thus delaying seeding. They are extremely slippery and sticky when wet, thereby restricting use of heavy machinery to dry periods. When dry, the hardpan is firm and resists cultivation by ordinary equipment. Only the top 12 to 18 cm of the soil can be cultivated, and, in dry periods, the soil moisture in this zone is rapidly consumed and crops suffer. For engineering uses, the high content of sulfate and soluble salts in the subsoil can pose a concrete corrosion hazard. The adverse drainage characteristics of the soil may affect some construction uses. For example, frost heave may be severe due to the retention of water near the surface in the fall and spring. BED 1 areas are almost always left in pasture within the mapped region. Native grasses such as spear grass and wheatgrasses are common, but some areas have been sown to alfalfa, clover and introduced rye, and wheatgrasses and smooth brome. These areas could be cultivated, but since they are generally small and represent some of the poorer arable land on most farms, they are, by choice, retained as pasture while the better soils are cultivated.

**BED 2**

BED 2 units occupy those upland portions of the till landscape that have been subjected to the influence of saline groundwater. Often, they are mapped on inclined or rolling bedrock-controlled morainal slopes. Seepage of saline groundwater from seams in the underlying bedrock produces areas of Solonetzic soils over parts of the slope. A few BED 2 units have been mapped in low-lying portions of the landscape where the water table is close enough to the surface to salinize the soil, but not close enough to result in the formation of wet soils (Gleysols). BED 2 consists of a majority of Beddington and closely related soils (60 percent) and a substantial component (40 percent) of deep, well-drained Delacour soil.

Soils within BED 2 unit display a wide variety of properties. Hardpan development ranges from strongly expressed to non-existent, often over very short distances. Thickness of topsoil varies considerably, with areas of thin topsoil usually associated with well-developed hardpans. High levels of soluble salts and sulfate occur in this unit, but their distribution is uneven.

As with BED 1 unit, the adverse physical structure and low permeability associated with the hardpan (Bnt) of Beddington soil affect the use of these areas. Hardpan development is not as extensive as in BED 1 unit, but is just as strong where it does occur. The Beddington soils in the unit dry out slowly after receiving snowmelt or rainfall. They are slippery and sticky when wet, and very hard and dense in the subsoil when dry. They interfere with cultivation and are droughty during dry periods. High soluble sulfate levels in the soil may contribute to corrosion of concrete or metal. Restricted drainage caused by the hardpan may contribute to increased frost heaving of roads or buildings. BED 2 areas are frequently left in pasture, but may occasionally be cultivated. Typical crops are hay, canola and barley.

**BED 3**

BED 3 units are usually mapped on gently undulating, low-lying morainal landscapes. Saline Gleysols (Balzac) occupy the depressions, well-drained Delacour soils the high spots, and Beddington soils generally form in the midslope positions. BED 3 consists of a variable mixture of Beddington soil (40 percent) associated with considerable proportions of deep, well-drained Delacour soil (30 percent) and wet, saline Balzac soils (30 percent).

This unit exhibits a wide variation in soil properties and wetness. Hardpan development is uneven and restricted to the Beddington soil component. The degree of wetness varies with the season, but the Balzac soils remain permanently moist and sticky. The wet soils are always saline and patches of salinity often develop on the drier soils as well.

Use of BED 3 areas is limited by the hardness and slow permeability of the Beddington soils, by wetness associated with both Balzac and Beddington soils and by the disruption of uniform use arising from the random pattern of occurrence of limiting and non-limiting soils. High salinity can reduce crop yields. High concentrations of soluble sulfate may cause a concrete or metal corrosion hazard. Localized wetness and a high water table throughout the unit reduce the capability of these areas to absorb effluent, serve as sanitary landfills or support well-drained building foundations. Areas mapped as BED 3 are almost all in pasture. They are very seldom cultivated and few improvement practices are followed.

## Bow Valley (BOV)

This is a thin, gravelly, rapidly drained black grassland soil. It forms on strongly calcareous glaciofluvial outwash gravels. The gravel is capped almost everywhere by a thin (<50 cm), loamy, aeolian or fluvial veneer (plate 17).

Bow Valley soil is most often found on level to gently inclined glaciofluvial terraces within and immediately adjacent to the Bow Valley. The natural vegetation is dominantly fescue grassland. The major species of grasses are rough fescue, porcupine grass, spear grass, wheatgrasses, June grass and blue grama grass. Some aspen, balsam poplar and willow grow along present or recently abandoned stream channels. Certain unique climatic conditions persist along the portion of the Bow Valley under investigation. Cold air drainage brings with it the potential for late spring or early fall frosts. Warm, drying winds maintain a grassland environment farther west than expected. Bow valley is defined as an agroclimatic zone 2H soil, but it is acknowledged to extend into agroclimatic zone 1 and 3H as well.

A characteristic profile of Bow Valley soil has a thin (<15 cm), loamy, black surface horizon and a bright brown subsurface horizon that form in the relatively stone-free aeolian or fluvial veneer. The underlying subsoil consists almost entirely of whitish to grayish, well-rounded, well-sorted gravels. Water infiltrates this soil rapidly, and there is little surface runoff. Except along stream channels, the water table exists at con-

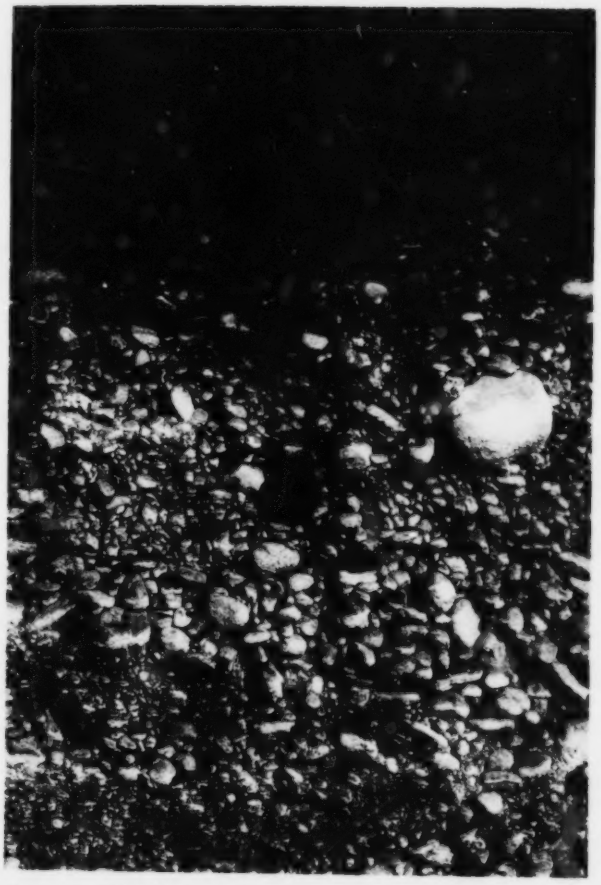


**Plate 17.** Bow Valley soil

siderable depth below the surface. Consequently, these soils tend to retain very little plant-available moisture and can become droughty. Bow Valley is an Orthic Black Chernozemic soil.

**BOV 1**
This unit is mapped on level to inclined glaciofluvial terraces. It consists almost entirely of Bow Valley soil. There are occasional small patches where the depth of material overlying the gravel may approach 1 m and a few areas of recently deposited gravel to the surface, but they are not extensive. The land surface is generally level or gently inclined, but individual terraces may be separated by steep, sharp slopes.

These areas are quite uniform with regard to the gravel subsoil, but the thickness of the overlying loamy cap can vary. Usually, there is about 30 to 50 cm of relatively stone-free capping material over the gravel.

Stoniness, rapid permeability and droughtiness are the main limiting features of this unit. Moisture deficiency and stoniness discourage cultivation of these soils. Rapid permeability may lead to contamination of groundwater supplies if excess use is made of these areas for septic filter fields or sewage lagoons. BOV 1 areas are almost always left in pasture. Occasionally, they may be used for irrigated hay crops.

**BOV 2**
This unit is mapped on inclined to steeply sloping ridges and escarpments. It consists of a thin, rubbly veneer of gravel resting on till or glaciolacustrine sediments. About 40 percent of the unit is Bow Valley soil. About 30 percent is a very weakly developed soil on less than 1 m of gravel overlying till or glaciolacustrine sediments. The remainder of the unit consists of stony, weakly developed soils developed entirely on till or glaciolacustrine sediments.

The steep slopes on which this unit is mapped have only a thin, interrupted cover of glaciofluvial gravel overlying glaciolacustrine sediments or till. Soil profile development is generally weak and thin. The texture of the soil below about 50 cm can vary considerably.

Agricultural use of this unit is severely limited by steep slopes, stoniness, droughtiness and erosion. Non-farm uses may also be adversely affected by stoniness, steep slopes, rapid permeability, erosion and variable subsoil textures. This unit occurs in only a few small areas and may be used for unimproved grazing. The gravel veneer is too thin to be of commercial interest.

## Bragg Creek (BRG)

Bragg Creek soils are thin, gravelly, rapidly drained, gray forested soils. They form on strongly calcareous glaciofluvial outwash gravels capped by a veneer of loamy fluvial or aeolian material.

The landscape is typically level to gently undulating glaciofluvial terraces and valley fill. The natural vegetation consists of white spruce with some aspen poplar. Black spruce and willow grow in wetter depressions. These soils develop under a cool, moist boreal climate. They are mapped within agroclimatic zone 5, where, by definition, the frost-free period is less than 60 days.

A representative profile of Bragg Creek soil has a thin surface mat of forest litter underlain by a light-colored, platy, leached horizon and a reddish brown oxidized horizon. There may be a gravelly accumulation zone of fine-textured material below this oxidized horizon and above the calcareous gravelly parent material. Drainage and infiltration are rapid on the elevated terraces, but some Bragg Creek soils occur close to base level for stream flow and may have water tables near the surface. Those areas affected by high water tables often contain soils that have higher than normal concentrations of sodium on their exchange complex.

Bragg Creek soil is classified as an Eluviated Eutric Brunisol. Often the accumulation of fine-textured material below the oxidized horizon results in the formation of a textural B horizon (Bt). In this case, a similar soil classified as a Brunisolic Gray Luvisol is recognized as occurring alongside Bragg Creek soil.

**BRG 1**
This unit is mapped on level to gently inclined glaciofluvial terraces and valley bottoms. Low-lying portions of units may be dissected by active or abandoned stream channels. BRG 1 areas consist mostly of

Bragg Creek and closely related gravelly soils. Gleysols which form in low spots in the landscape may occupy as much as 20 percent of the unit.

These areas are always gravelly, but vary in the thickness of the overlying veneer and in the degree of profile development, as indicated by clay accumulation. They are rapidly permeable, but may be moist in low-lying areas due to high water table levels.

Climate is the overriding constraint to agricultural use for these soils, but stoniness and rapid permeability also limit their usefulness. Engineering uses are affected by high coarse fragment content, rapid permeability and proximity of the water table. Problems may be encountered with contamination of groundwater when septic filter fields are installed in these areas. Most BRG 1 areas are forested, but a few have been cleared for use as improved pasture. Considerable residential and recreational development is concentrated on these soils in the vicinity of Bragg Creek townsite.

## Connop (CON)

This is a light-colored, somewhat saline, moderately leached, sandy forested soil. The parent material is coarse loamy, extremely calcareous glaciofluvial outwash sand.

Connop soils occupy only small areas and are not associated with distinctive landscapes. They occur in abandoned drainage channels of the preglacial Elbow River wherever the sand is not overlain by fine clayey till. They have also been mapped as isolated areas of ice-contact deposits. They commonly occur under a mixed pine-aspen forest with a thin understory dominated by grasses. The climate is dominantly cool and moist, and is characterized as agroclimatic zone 5 for agriculture. Frost may occur at almost any time during the summer months, so the average frost-free season is very short.

Connop soil has a thin surface mat of forest litter overlying a light-colored, silty leached horizon and reddish brown oxidized zone, which is enriched in clay. These horizons are mildly acidic, while the sandy parent material is neutral to alkaline and extremely calcareous. The high permeability of these soils results in rapid infiltration and internal drainage of water. Most mapped areas are too small to have significant surface drainage features.

Connop soil is classified as an Eluviated Eutric Brunisol. Some pedons contain enough sodium in the B horizons to meet the chemical requirements of a solonetzic Bnt, but the soil has not been classified as a Solod because it lacks the structure characteristic of this great group.

### CON 1

This unit is usually mapped on nearly level topography, but some areas are ridged or hummocky. The rough topography is associated with esker and ice-contact deposits, while the level topography occurs in outwash areas. CON 1 areas are broadly defined to consist of mostly Connop soil and variable amounts of contrasting soils. They may be all Connop or can contain large amounts of Spruce Ridge, Robinson or Elbow soils.

A good deal of variability is included within CON 1 areas. This is because there are too few occurrences of this sandy soil to justify creation of several units to describe the various combinations of soil with which it occurs. The thickness and extent of the sand deposit is variable, as are the amounts of other materials such as till included within a given mapped area. The unit indicates the presence of sand, but does not predict its extent.

The short frost-free period is the overriding constraint to agricultural use of CON 1 areas. Other uses are affected by the rapid permeability of the sandy subsoil and by its susceptibility to erosion if disturbed. CON 1 areas are presently forested and little use is made of them other than for rough pasture. Some trees are harvested for firewood.

## Delacour (DEL)

Delacour is a deep, well-drained black grassland soil formed on till in agroclimatic zone 1. The till is fine loamy in texture, has few coarse fragments (<5 percent), is strongly calcareous and is Continental in origin.

Delacour soil forms on undulating to gently rolling morainal landscapes. Relief is low and only occasionally controlled by the topography of the underlying bedrock. The major relief changes occur where glacial meltwater channels cut below the level of the surrounding plain. Almost all Delacour soil areas have been broken and cultivated. The original vegetation was undoubtedly mixed prairie grassland. The most common original vegetation consisted of spear grass, rough fescue, blue grasses, porcupine grass, June grass and blue grama grass. Delacour soil is mapped within agroclimatic zone 1. Rainfall is generally adequate and averages 400 mm annually. The frost-free period is generally greater than 90 days per year.

Delacour soil has a thick black to dark brown surface horizon (15 to 25 cm) overlying a strongly structured prismatic, oxidized subsurface horizon and a whitish gray to buff till subsoil (plate 18). It is well drained, moderately pervious and has adequate moisture retention. Natural integrated drainage networks are not well developed in this unit. Most precipitation flows overland for short distances and collects in local undrained depressions, where it infiltrates the soil. The man-made irrigation canal and reservoir system of the irrigation district constitutes a limited integrated drainage system for the area.

Delacour is an Orthic Black Chernozemic soil. It occurs in an area subject to discharge of saline groundwater. Consequently, some profiles in Delacour soil areas show weak Solonetzic features and may be classified as Solonetzic Blacks.

### DEL 1

DEL 1 unit is mapped on level to gently rolling morainal topography. The land surface is generally smooth and slopes are simple and uniform. DEL 1 consists almost entirely of Delacour and other similar soils. It may con-

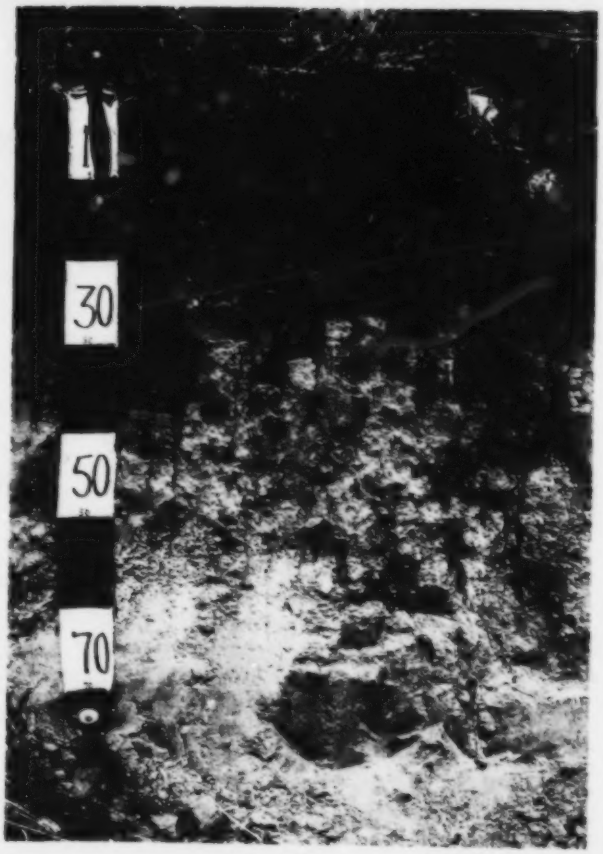



**Plate 18.** Delacour soil

tain minor amounts (< 15 percent) of Gleysolic or other contrasting soils, but these are not of sufficient extent to affect the interpretation of the unit for most uses.

There is only limited variability of important soil properties within this unit. It is uniformly well drained and surface stoniness is slight. Textural changes are small within outlined areas. There is some evidence of soil drift resulting in changes in the thickness and composition of the surface horizon.

This unit presents few serious limitations for most uses. The climate and soil properties favor the growth of all crops normal to the region. Consideration should be given to controlling potential wind erosion. There are few soil properties that severely limit engineering uses, but soluble salts may be present at depth in this soil and may create a concrete corrosion hazard. DEL 1 areas are extensively cultivated to wheat, barley, canola, oats, flax and forage crops.

**DEL 2**

This unit is mapped on gently undulating to subdued hummocky, morainal topography. Saline groundwater is close to the surface over the whole area. Slight irregularities of the surface result in scattered depressions which are affected by this saline groundwater. About 80 percent of the unit is Delacour or similar, well-drained soils and the remaining 20 percent is mostly wet, saline Balzac soil.

There is some variability in soil wetness, depth to water table and salinity in this unit. Most of the area resembles DEL 1, but the presence of numerous wet spots must be considered.

The majority of the area within DEL 2 units has few constraints for most uses. The Balzac soils are limited by wetness, salinity, adverse physical structure and high clay content. They are poorly suited for most agricultural and engineering uses, but in this unit they are not extensive enough to restrict efficient use of the dominant, well-drained Delacour soil. Most DEL 2 areas are cultivated to standard cereal and forage crops. There is only slight disruption of normal cultivation patterns and a slight reduction in yield caused by the scattered Gleysols.

**DEL 3**

This unit is mapped on nearly level to gently undulating morainal landscapes. Numerous small, enclosed depressions give rise to an irregular, pock-marked landscape. About 60 percent of the unit is Delacour or similar, weakly developed Sharp Hill soil and about 40 percent is wet, saline Balzac soil. Elevation changes of as little as 1 m separate the poorly drained Balzac soil areas from well-drained Delacour soil (plate 19).

There are rapid and substantial changes in depth to water table, soil wetness, salinity and soil texture over small distances within this unit. Most changes are predictable and associated with landscape position. Wet, clayey, saline soils occur in depressions, while well-drained, non-saline, fine loamy Delacour soils occupy somewhat higher ground. Saline spots sometimes occur randomly within the well-drained Delacour soil component.

The poorly drained Balzac soil is unsuitable for most agricultural or engineering uses. It is wet, saline, susceptible to inundation, and has adverse physical structure and high clay content. Further, the pattern of distribution of this Gleysol limits the normal use of the remaining well-drained soil. DEL 3 areas may occasionally be cultivated to normal grain crops, but are more often seeded to forage crops or used for pasture. For such uses, the wet soil component is far less limiting than for regular cultivation.

**Plate 19.** DEL 3 topography

**DEL 4**

The landscape associated with DEL 4 units is similar to that on which DEL 1 is mapped. Slopes are usually smooth and uniform and there are few wet depressions. This unit consists principally of Delacour and very similar soils (80 percent) but includes a minor component (20 percent) of thin, black, hardpan Beddington soil. There is often no discernible reason for the presence of Solonetzic soils in these areas.

It is predicted that some 15 to 30 percent of any given DEL 4 area will have the hardpan characteristic of Beddington soil. The unit is otherwise quite uniform, in that all soils are well to moderately well drained, the parent material is till of a restricted textural range, and soil salinity, while variable, is neither strong nor extensive.

This unit presents only minor constraints for most uses. The climate is favorable for all crops normally grown in the area. The hardpan which forms over a minor portion of each area creates a moderate, adverse structure limitation for agriculture in that portion of the unit. The remaining deep, well-drained Delacour soils have no serious limitations, although wind erosion and salinity may occasionally present minor problems. DEL 4 areas are extensively cultivated. The major crops are wheat, barley, canola, oats, flax, alfalfa and hay.

**DEL 5**

This unit develops on low-lying, undulating to subdued hummocky morainal landscapes. Discharging, saline groundwater occurs close to the soil surface and contributes to the formation of Beddington and Balzac soils. DEL 5 is broadly defined as a variable mixture of significant amounts of wet, saline Balzac (30 percent) and thin, hardpan Beddington (30 percent) soils, randomly distributed in a matrix of deep, well-drained Delacour (40 percent) soil. The wet Balzac soil may change to a somewhat better-drained Beddington soil or well-drained Delacour soil, with an increase in surface elevation of as little as 1 m.

DEL 5 unit is highly variable in terms of several properties. The depth to water table and degree of soil wetness change rapidly over relatively short distances. The hardpan characteristic of Beddington soils is erratically distributed throughout the unit. Surface and sub-surface salts are present in varying amounts. Balzac soils are almost always strongly saline to the surface, Beddington soils are frequently strongly saline at depth and Delacour soils are usually non-saline except at depth. Occasionally, patches of surface salinity occur on both the Beddington and Delacour components of this unit.

There are numerous limitations affecting most uses of this unit. The high water table, numerous wet soils and high soil and groundwater salinity adversely affect cultivation and engineering use. The hardpan of Beddington soil hinders cultivation, impedes drainage and restricts rooting depth. The rapid change in soil properties over short distances creates pattern limitations which prevent most forms of uniform use from being applied to these areas. DEL 5 areas are rarely cultivated. They are usually left in pasture and used for grazing.

**DEL 6**

DEL 6 areas occur on undulating to slightly hummocky morainal topography. The landscape is generally raised above the influence of discharging saline groundwater. Surface runoff accumulates in scattered minor depressions and infiltrates the soil, resulting in the strongly leached profiles and wet soil conditions characteristic of Indus soil. The larger depressions are invariably surrounded by a ring of willow and sometimes balsam poplar vegetation. This unit consists principally of Delacour and closely related well-drained soils (70 percent), but includes a substantial component of deeply leached, non-saline, wet, Indus soil (30 percent).

DEL 6 units have few constraints for most uses. The portion of the area occupied by Indus soils is affected by wetness and periodic inundation, but is nonetheless often cultivated. The remainder of the area behaves similarly to DEL 1 and is subject to minor salinity problems and possible wind erosion. DEL 6 areas are usually cultivated to grain and forage crops.

**DEL 7**

This unit is mapped on undulating to slightly hummocky morainal topography. It is similar to DEL 1 except that the slightly rougher topography results in more rego, thin and eroded profiles than in DEL 1. About 50 percent of the unit is Delacour soil and about 40 percent is a less-strongly developed soil classified as a Rego Black. The remainder of the unit is mostly gleyed soils and Gleysols.

Variability within this unit is related mainly to the effects of the rougher surface topography. Rapid surface runoff reduces infiltration and contributes to erosion (plate 20). These, in turn, result in thinner, moderately developed soil profiles.

This unit has few serious limitations for most uses. The climate favors the growth of all crops normal to the region. The observed presence of eroded soils indicates that soil erosion may be a moderate limitation to agricultural use of the unit. Soluble salts may be present at depth and may present a concrete corrosion hazard. DEL 7 areas are usually cultivated to wheat, barley, oats, canola, oats or forage crops.

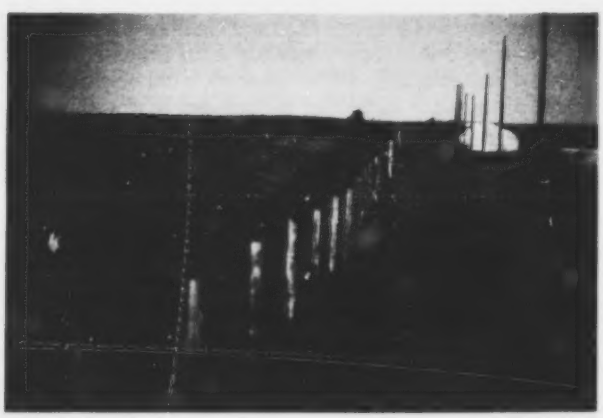


**Plate 20.** DEL 7 wind erosion

**DEL 8**

DEL 8 is mapped along minor stream channels and natural drainage ways cut into the till plain east of Calgary. The unit contains mostly Delacour soil along with a lesser component of wet, depressional soils (Balzac, Indus) and some alluvial stream channel soil (Tweedsmuir). The channel sides rarely have slopes steeper than 9 percent or less than 3 percent. The alluvial soil in the channel bottom, if present, is thin and overlies till. It is impractical to try and separate the stream channels containing saline soils from those that are non-saline.

This unit varies in steepness and orientation of its slopes, in wetness and depth to water table, in soil salinity, and in parent material texture and related properties. This variability makes it difficult to interpret the unit for some uses.

Use of DEL 8 areas is limited mostly by the pattern disruption caused by the presence of a stream channel in the middle of the unit. Other factors which affect the use of this unit are soil wetness, susceptibility to flooding and high silt content in the stream channel portion of the unit, and steep slopes along the bounding sides. DEL 8 areas are almost always in pasture or used for watering and grazing livestock. Much of the unit is left idle.

**DEL 9**

This unit is found on well-drained till ridges that are believed to have cores of glaciofluvial sand below the normal depth of soil investigation. About 50 percent of the unit consists of deep, well-drained Delacour soil and 30 percent is thinner, moderately developed Sharp Hills soil. The remainder of the unit consists mostly of slightly more silty Eastbow or Rockyview soils.

The variability within this unit is not large and is related primarily to rapid surface runoff and erosion or to slight changes in parent material texture. Erosion and surface runoff result in the thin, poorly developed profiles exhibited by Sharp Hills soil. Scattered patches of silty loess give rise to the observed Eastbow and Rockyview profiles. Sandy glaciofluvial material was seldom encountered within the 1 m control section used to define soil series, but the underlying sand was thought to be partly responsible for scattered droughtiness observed in crops growing on these ridges.

Generally, this unit presents only slight to moderate constraints for most uses. Agriculturally, it has a favorable climate, and most crops common to the region can be grown. The sloping topography may present a moderate limitation to agriculture, as can droughtiness and erosion. Non-farm uses are sometimes limited by steep slopes or by rapid permeability of the suspected underlying sand.

DEL 9 areas are usually cultivated to the same crops as adjacent DEL 1 areas. Wheat, barley, canola and forage are the most common crops grown. No areas are presently exploited as sources of sand, probably because the deposits are too small or the material contains an unacceptably high proportion of fine-textured material.

**DERK 1**

This unit is found on smooth, level to undulating morainal landscapes that have a thin patchy veneer of silty loess scattered over their surfaces. About 50 percent of the unit is deep, well-drained Delacour soil and about 30 percent is a similar deep, well-drained soil (Rockyview) that has a silty surface veneer, thought to be loess. The remainder of the unit consists of minor amounts of Eastbow, a thin, poorly developed soil developed on silty loess overlying till, or Midnapore, a deep, well-developed, somewhat sandy soil.

Variability within this unit arises primarily from the irregular distribution of the silty surface veneer. No pattern is evident, but areas mapped as DERK 1 always contain some patches of silty loess. The unit is otherwise quite uniform.

There are no severe constraints to agricultural use of this unit. The climate favors growth of all crops common to the region and soil conditions are favorable except for a slight erosion hazard. Non-farm uses may be limited by a frost heave hazard in the locations where silty Rockyview or Eastbow soils occur. There are no other severe limitations for most non-farm uses.

Presently, most DERK 1 areas are cultivated to wheat, barley, alfalfa, canola or hay.

**DERK 2**

This unit is found on level to undulating, slightly pitted, morainal landscapes that have scattered thin patches of silty loess overlying the till. About 30 percent of the unit is deep, well-drained Delacour soil; another 30 percent is deep, well-drained, silty Rockyview soil; and 30 percent is poorly drained, deeply leached Indus soil. The remainder of the unit consists of variable amounts of Eastbow or Midnapore soil.

The texture and origin of the soil parent material in this unit varies from fine loamy till to fine silty aeolian. Drainage class is also variable. The majority of the unit is well drained although 20 to 40 percent is poorly drained.

The well-drained portions of this unit have few limitations for most uses, while the poorly drained portions have moderate to severe limitations. The climate favors growth of all crops common to the region. The pitted surface and poorly drained soils interfere with uniform cultivation, producing a slight limitation for agricultural use of the unit as a whole. The poorly drained soils display moderate limitations for agricultural use. Non-farm uses may be limited by wetness in some portions and by silty soil textures in other areas.

DERK 2 areas are frequently cultivated to the same crops as DERK 1 areas, but reduced yields may be expected due to flooding and soil wetness in the scattered depressions.

## DeWinton (DWT)

DeWinton is a poorly drained, weakly developed, depressional soil formed on recent slough deposits overlying till or bedrock in agroclimatic zones 1 and 2H. The slough deposits have a variable texture (usually fine clayey), contain few stones and are often

strongly calcareous throughout their depth. They generally overlie fine loamy till, but a lithic unit has been mapped, in which bedrock is encountered within 1 m of the surface.

The soil forms in shallow depressions within undulating to hummocky morainal or glaciofluvial landscapes. Material eroded from surrounding areas collects in the depressions, as does runoff and infiltration water. Only a few large areas of DeWinton soil are mapped separately. It is usually included as a minor component in other dominantly well-drained units. Vegetation consists primarily of grasses and sedges, with the occasional willow or aspen around the perimeter.

A representative profile of DeWinton soil has a black, highly organic surface layer that often contains free lime. This is underlain by a dark transition horizon that contains less organic matter and more carbonate, but has mottles indicative of periodic soil wetness. The light colored subsoil is strongly calcareous, usually contains numerous mottles and has a silt loam to silty clay texture. Periodic accumulations of surface runoff and local subsurface infiltration help to maintain a high moisture level in this soil. It is, therefore, poorly drained. Most drainage in these areas occurs through slow downward infiltration into the groundwater flow system.

DeWinton is classified as a Rego Humic Gleysol, carbonated phase. Other similar soils of slightly different classification are frequently mapped in association with DeWinton. Some are identical except that they are not carbonated to the surface. Others have a definite B horizon and are Orthic Humic Gleysols. Often soils in the perimeter of areas mapped as DeWinton are leached and more properly classified as Humic Luvic Gleysols.

**DWT 1**

This unit is mapped in wet, clay-infilled depressions of low-lying morainal and glaciofluvial landscapes. It consists almost entirely of DeWinton and closely related wet, black, depressional soils.

DWT 1 areas are uniformly wet and nearly level. Soil texture is the most important variation. The parent material is always quite silty, but the clay content may vary considerably. Soil classification also varies as a result of slight leaching, development of true B horizons or absence of lime at the soil surface, though all soils remain Gleysols.

Use of these areas is limited primarily by their wetness and susceptibility to flooding. High clay content and low permeability may result in moderate to severe limitations for some uses. Areas large enough to be mapped as DWT 1 are usually left in rough pasture. Smaller areas of DeWinton, within dominantly well-drained units, are often cultivated, despite the problems caused by their wetness.

**DWT 2**

This unit is mapped in wet, low-lying, clay-infilled depressions of the morainal landscape. Bedrock is often found within 1 m of the surface. About 40 percent of the unit is DeWinton soil and 40 percent is a similar unnamed lithic soil that has a bedrock contact within 1 m of the surface. The remainder of the unit consists mostly of wet, slightly leached soils, which occur towards the margins of the depressions.

DWT 2 areas are similar to DWT 1 areas except that they have bedrock within 1 to 2 m of the surface.

Use of these areas is limited by wetness, susceptibility to flooding, high clay content, low permeability and depth to bedrock. Most areas are left in native grass or sown to pasture.

**DWT 3**

This unit is mapped in low-lying, wet, depressional, clay-infilled portions of glaciofluvial channels. The depressions are very poorly drained and often have thin veneers of organic material. About 50 percent of the unit is DeWinton soil and another 30 percent is a peaty phase of this soil. Up to 20 percent of the unit may be a very poorly drained, organic soil, classified as a Terric Mesisol.

DWT 3 areas are always wet or inundated. They present severe limitations for most uses, due primarily to wetness, high water table, groundwater contamination hazard or organic surface material. Only a few DWT 3 areas were mapped. It was noted that all were left undrained and in their natural marshy state.

**DWHP 1**

This unit is mapped in low-lying, wet depressions in glaciofluvial landscapes. The land surface is irregular, and minor knolls arise out of the predominantly depressional landscape. About 60 percent of the unit is poorly drained DeWinton soil and 30 percent is rapidly drained Happy Valley soil. Minor amounts of Eastbow or Delacour soils may also be present.

Soil wetness and texture vary in this unit in relation to landscape position and soil type. The depressions are infilled with clay, are poorly drained and are subject to flooding. Slightly higher areas are well to rapidly drained and are sandier in texture.

Use of these areas is limited primarily by their wetness and susceptibility to flooding. High clay content, and low permeability also contribute to moderate-to-severe limitations. Use of the better drained portions of the unit is limited by disruptions caused by the numerous wet areas, as well as by rapid permeability and susceptibility to erosion.

DWHP 1 areas are generally too wet for cultivation. They are frequently flooded and support a vegetation of marsh grasses, sedges and occasional willow or aspen poplar around their margins.

## Dunvargan (DVG)

Dunvargan is a deep, well-drained, black, grassland soil formed on till in agroclimatic zone 3H. The till has a fine loamy texture, contains a moderate amount of coarse fragments (10 to 20 percent), is moderately to strongly calcareous and is of mixed Continental and Cordilleran origin.

Dunvargan soil forms on undulating to ridged or strongly inclined morainal landscapes. In valleys, Dunvargan occurs on smooth, undulating to gently rolling

surfaces of thick till deposits. In upland areas, the till is often only 1 to 2 m thick and directly overlies ridged or flat-lying bedrock, mostly Paskapoo or Porcupine Hills Formation.

This soil developed under a typical parkland type vegetation dominated by fescue grassland and periodic aspen forest cover. The open areas support fescue and other grasses as well as wolf willow, pasture sage, buffalo bean, lupin, cinquefoil, puccoon, saskatoon and some scattered willow, aspen and swamp birch. The forested areas consist of aspen poplar, willow, balsam poplar, white birch *(Betula papyrifera)* and white spruce with an understory of lupin, fireweed, rose, vetch, northern bedstraw, cow parsnip, tall lungwart (bluebells), *(Mertensia paniculata)*, Soloman's seal, wild geranium and dogwood. Dunvargan soil is assigned to agroclimatic zone 3H, in which the annual precipitation is adequate for most crops, but the frost-free period of 60 to 75 days is considered to be a moderate limitation to growth. Not all Dunvargan soil areas have such a defined climate. Changes in slope position, aspect and elevation result in considerable variation from this climate pattern over very short distances. Long, smooth, south-facing slopes on uplands receive more sunlight and have cool air drained away at night, so they may have longer growing seasons. North- and east-facing slopes and valley bottoms receive less sunshine or are subjected to cold air drainage and, consequently, may have very short frost-free seasons. The 3H designation is a compromise assessment of the modal climate of this soil region.

Dunvargan has a black surface horizon generally greater than 15 cm thick, overlying a weakly prismatic, moderately oxidized subsurface horizon and a whitish gray to buff till subsoil. It is well drained, moderately pervious and has adequate moisture retention. An integrated drainage network exists in most areas of gently rolling topography. On steep slopes, Dunvargan soils drain by overland flow or through numerous minor gullies that channel water down hillsides.

Dunvargan is an Orthic Black Chernozemic soil. It occurs in an area subject to periodic and shifting tree cover, which may produce signs of weak leaching in some profiles. Leighton Centre soil is mapped where soils are moderately leached, but occasional small areas of weakly leached soils may be included in some Dunvargan soil units. These leached profiles are classified as Dark Gray Chernozemic or Dark Gray Luvisolic.

**DVG 1**

This unit is mapped on undulating to gently sloping or gently rolling morainal topography. The land surface is generally smooth, slopes are simple and uniform, and there are very few wet depressions. About 70 percent of the unit is well-drained Dunvargan soil and 20 percent is a similar soil that is slightly leached. Imperfectly to poorly drained soils and some thick soils arising from slopewash accumulation make up the remaining 10 percent of the unit.

There is limited variability of important soil properties within this unit. It is uniformly well drained and surface stoniness is slight. The parent material is always till of a limited textural range. The surface horizon may vary in depth, but is usually more than 15 cm thick. Along most toe slopes, slopewash may contribute to unusually thick black surface horizons. At boundaries with lacustrine soil units, Dunvargan parent material may show some lacustrine features, such as weak bedding or high clay content.

The short frost-free season limits the types of crops that can be grown in this unit to those that mature rapidly. The soil properties and landscape are otherwise favorable to cultivation. These areas are well drained, moderately permeable and are not excessively stony. Moderately high clay content may adversely affect some non-farm uses. DVG 1 areas are used for improved pasture and production of coarse grains or forage crops. Most of the oats and barley grown are used for green feed, even though, in most years, they could ripen.

**DVG 2**

This unit is mapped on somewhat rougher morainal landscapes than DVG 1. The topography is gently undulating to slightly hummocky. The surface irregularities give rise to scattered depressions in which water accumulates and wet soils form. DVG 2 areas consist mostly of Dunvargan and similar well-drained soils (80 percent), but include an important component of unnamed wet soils and open water (20 percent).

The major differences in this unit are related to soil wetness and depth to water table. Most of the area is well drained except for the wet depressions. The rougher topography leads to rapid surface runoff and moderate long-term erosion. Consequently, soil profiles are often thin near the tops of knolls and thicker in depressions. Tree growth is favored near areas of moisture accumulation, and the resulting growth is protected by the somewhat rough topography. Therefore, scattered aspen groves are more frequent in this unit than in DVG 1, and some soils in these areas exhibit evidence of weak leaching.

Most of the soils in this unit have the same slight limitations discussed for DVG 1. Often, they are further limited by rougher topography or pattern disruption. The wet soils are limited by high water table, susceptibility to flooding and high frost hazard. DVG 2 areas are used for pasture and sometimes for forage or coarse grain production. When cultivated, the scattered areas of wet soil are generally avoided, thereby reducing the overall usefulness of these areas.

**DVG 3**

DVG 3 is mapped on moderate to strongly sloping till-covered hillsides (plate 21). The till forms a mantle from one to several meters thick over sandstone bedrock. This unit contains mostly Dunvargan soil (50 percent), but also includes soils that are thinner, less-strongly developed, drier and more shallow to bedrock than normal Dunvargan.

Most variability in this unit results from the effects of steep slopes or underlying bedrock. Water drains rapidly downslope, carrying considerable material with it. Topsoil is eroded from the upslope portions of the

**Plate 21.** Dunvargan soil on hill slope

landscape and redeposited in depressions and along toe slopes. There are more thin soil profiles within this unit than in DVG 1. Since most precipitation drains away rapidly, these soils frequently have less available moisture than those in DVG 1 units. Available moisture is usually concentrated in gullies and narrow drainage paths that dissect the hillsides. Bedrock often occurs within 50 to 300 cm of the surface.

Use of this unit is mainly limited by the steepness of its slopes. Other factors which tend to constrain its use are stoniness, shallow depth to bedrock, low availability of soil moisture, erosion potential and, in certain instances, slope instability. DVG 3 areas are almost always left in pasture. Few improvements are made, and the steep slopes usually preclude hay cultivation.

**DVG 4**

This unit is found on undulating to slightly hummocky or ridged morainal landscapes. The minor surface irregularities result in rapid surface runoff and increased erosion, relative to adjacent smoother landscapes. About 40 percent of the unit is deep, well-drained Dunvargan soil and 30 percent is a similar, thinner, less-strongly developed Rego Black soil. The remainder of the unit consists of thin or eroded phases of these two main soils and minor amounts of Gleyed or Gleysolic soils.

Variability in this unit is related mainly to the effects of erosion and rapid surface runoff resulting from the irregular topography. Profile development is impeded by the rapid surface runoff or destroyed by erosion, resulting in thin and poorly developed soil profiles. The unit otherwise has a uniform till parent material and is almost entirely well drained.

This unit has several soil related constraints for most uses. Agriculturally, it is mapped within agroclimatic zone 3H, in which the short frost-free season of 60 to 75 days results in a moderate limitation to crop growth. Minor erosion may be a further limitation to agriculture. There are few severe limitations for most non-farm uses.

This unit is similar in many respects to DVG 1 and is cultivated to much the same crops. Most areas are used for alfalfa or hay, but oats, barley and some canola are also grown.

**DVFS 1**

This unit is mapped in areas of rough, hummocky topography in which morainal and glaciolacustrine parent materials are complexly mixed. These areas are often located at the margins of former glaciolacustrine basins. The unit consists of almost equal amounts of deep, well-drained Dunvargan till soil (40 percent) and fine clayey, moderately well-drained Fish Creek glaciolacustrine soil (40 percent). It also contains a notable component of wet, clayey Pothole Creek soil (20 percent).

Parent material texture and related properties vary widely and unpredictably within this unit. Large bodies of fine-textured glaciolacustrine clay may be encountered within the till matrix. They are sometimes exposed at the surface and other times exist as buried inclusions in the till. Substantial changes in parent material texture, bearing strength, shrink-swell potential, permeability and water content must be anticipated for small changes in vertical or horizontal position within DVFS 1 areas. The numerous depressions found in these hummocky areas accumulate water. Consequently, wet soil conditions exist over a portion of the unit. Soil profiles are somewhat variable, but are similar with respect to their black surface horizons and are defined for Dunvargan and Fish Creek individually. Soils are frequently thin near the tops of the numerous knolls.

Use of areas mapped as DVFS 1 is limited by rough topography and numerous short, steep slopes. The relatively short frost-free season restricts potential crops to rapidly maturing grains, green feed, forage and pasture. The scattered wet depressions are usually unsuited to agriculture and can disrupt the efficient use of the remaining well-drained soils. The erratic distribution of parent materials with substantially different properties presents numerous limitations for many engineering type uses. The glaciolacustrine component has a high clay content, high shrink-swell potential and low permeability. It may adversely affect some construction uses. The cost of building structures or roads in this unit may be increased by the necessity of increasing the density of on-site investigations. DVFS 1 areas are normally used as pasture.

**DVFS 2**
This unit is mapped on landscapes of rough, hummocky topography in which morainal and glaciolacustrine parent materials are complexly mixed. DVFS 2 areas contain a highly complex mixture of soil types and parent materials. Black grassland soils, formed on till (Dunvargan) or fine-textured glaciolacustrine clay (Fish Creek), predominate, but light-colored, leached forested soils also occur on both parent materials. Wet, clayey Pothole Creek soil forms in the numerous depressions. DVFS 2 areas have substantial tree cover, primarily aspen poplar.

There is considerable variation in soil properties within this unit. The parent material changes unpredictably from till to fine-textured clay to a mixture of the two with only small changes in horizontal or vertical position. The types of soil profiles encountered also vary considerably. Black grassland soils form in open areas and on south-facing slopes. Forest cover is greater in protected areas, particularly on north- or east-facing slopes. Here, soils are light-colored, leached and have subsurface horizons enriched in clay. They may form either on till (Leighton Centre) or on fine glaciolacustrine clay (Elbow). Most soils in this unit are moderately well drained, but there are numerous low wet spots.

Use of DVFS 2 areas is limited by the short frost-free period, by rough topography and short, steep slopes, by numerous wet depressions and by the unpredictable distribution of parent materials. The leached forest soils of this unit are less suitable for agricultural use than are the black grassland soils which dominate DVFS 1. They have adverse physical structure, are more susceptible to erosion if disturbed and have a lower nutrient-holding capacity. Usually, these areas are partially forested. Clearings are used for forage and improved pasture, while the forested areas function as native pasture.

## Eastbow (EBO)

Eastbow is a shallow, weakly developed, black grassland soil formed on thin loess overlying sandy glaciofluvial and till in agroclimatic zone 1. The parent material consists of a veneer of fine silty, strongly calcareous, aeolian material overlying a thin layer of sandy to coarse loamy glaciofluvial material resting on till. This soil occurs on nearly level to undulating landscapes.

Most areas of Eastbow soil are cultivated, and little natural vegetation remains. Undisturbed areas have a cover of native grasses consisting of spear grass, wheatgrasses, blue grama grass and June grass. Eastbow is mapped primarily within agroclimatic zone 1. Precipitation averages 400 mm per year and the frost-free period is usually greater than 90 days.

A representative profile of Eastbow soil has a thin, black, loamy surface horizon which rests directly on calcareous parent material. The parent material is initially silty, but becomes more sandy with depth until a contact with fine loamy till is encountered (plate 22). The soil is well to rapidly drained, moderately pervious and has low to moderate moisture retention. Integrated drainage networks are rare in Eastbow areas and deranged drainage predominates.

Eastbow is classified as a Rego Black Chernozemic soil. Similar soils, included when mapping, are classified as Calcareous Blacks and Orthic Regosols.

**EBAD 1**
This unit is found on smooth, level to gently rolling, morainal landscapes which are covered with a thin silty aeolian veneer. There are occasional pockets of sandy loam between the till and the loess. About 40 percent of the unit is well-drained, weakly developed, silty, Eastbow soil and 20 percent is well-drained Academy soil. The remainder of the unit consists of various amounts of Happy Valley, Rockyview or Midnapore soils.

This unit has a complex mixture of parent materials, whose distribution cannot be predicted from readily observable landscape features. Some profiles have silty surface veneers overlying till. In others, sandy loam underlies the silty loess or occurs to the surface. Still others are recognized as being formed entirely in till. The texture of the top 1 m throughout this unit can be expected to vary from sandy loam to silty clay loam. At greater depths, the parent material is generally fine loamy till. Soil profiles also vary from predominantly thin and weakly developed to lesser amounts that are deep and well developed.

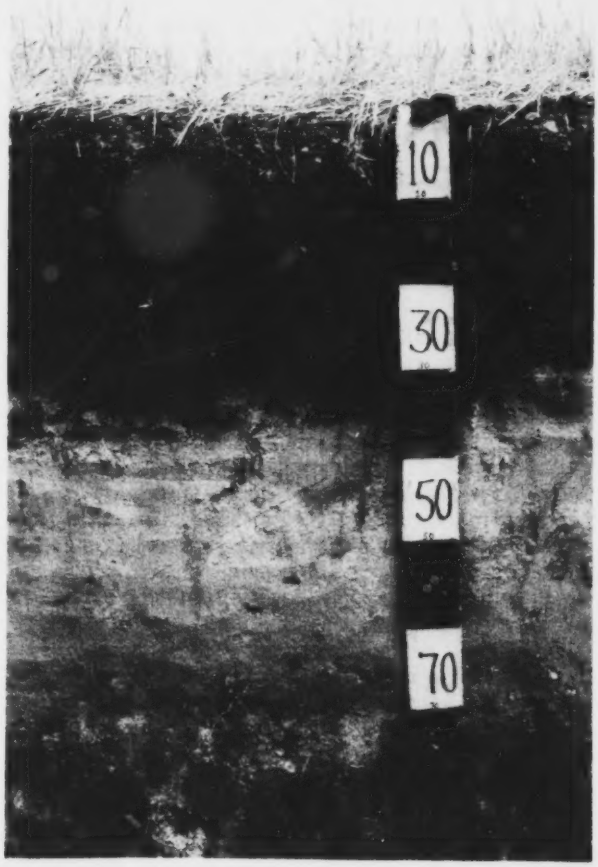



**Plate 22.** Eastbow soil

Agricultural use of this unit is not limited by climate, but observed soil erosion and pockets of droughty soils may result in slight to moderate limitations for crop growth. Non-farm uses may be affected by the variability in texture of the top 1 to 2 m and by scattered spots of rapid permeability or high silt content soils.

EBAD 1 areas are mostly cultivated to wheat, barley, canola, alfalfa or hay.

**EBAD 2**

This unit is found on slightly pitted, level to undulating, morainal landscapes that are covered with a thin silty aeolian veneer. There are occasional pockets of sandy loam between the till and the loess. About 30 percent of the unit consists of well-drained, silty Eastbow soil and 30 percent is deep well-drained Academy soil. From 10 to 30 percent of the unit may be wet, depressional DeWinton soil and the remainder consists of rapidly drained, sandier soils such as Happy Valley.

This unit has a complex mixture of parent materials similar to EBAD 1 and also includes fine clayey, recent lacustrine sediments in the infilled depressions. Soil wetness and drainage class vary considerably within the unit. As with EBAD 1, the parent material below 1 to 2 m is mostly fine loamy till. Thin, weakly developed or eroded profiles dominate the unit, although some soils are deeper and more strongly developed.

Crop growth in this unit is not limited by climate, but soil conditions may impose slight to moderate limitations to agricultural use. Erosion, droughtiness and adverse wetness affect different portions of this unit. Non-farm uses may be affected by the variability in texture of the top 1 to 2 m as well as by scattered areas of rapid permeability, adverse soil wetness or high silt content soils.

EBAD 2 areas are used for forage or pasture or cultivated to wheat, barley or canola.

## Elbow-Robinson (ELRS)

Elbow and Robinson soils were always mapped in combination, as it proved impractical to consistently differentiate them and to map separate areas of uniquely Elbow or Robinson soil. Both are deep, moderately well-drained, dark gray forested soils located within agroclimatic zone 5H. Elbow forms on fine clayey glaciolacustrine sediments and Robinson on fine clayey till. Apart from their differences in origin, these two materials have similar appearance and properties. These soils occur on nearly level to steeply sloping bedrock highs and within narrow northwest-trending foothills and valleys south and west of Calgary.

These soils are found under a forest vegetation. Some areas are mainly lodgepole pine with minor aspen and an open understory dominated by grasses and mosses. Other areas contain a mixture of aspen, white spruce, balsam poplar, willow, birch and lodgepole pine and have a typical Boreal Forest understory. Both soils are confined to agroclimatic zone 5H. Precipitation exceeds 500 mm per year and the frost-free period is less than 60 days.

A representative profile of either soil has a thin, black surface mat of poorly decomposed leaf litter (plate 23). Underlying the surface mat is a horizon of dark gray mixed mineral and organic material slightly more than 5 cm thick. This overlies a light-colored, friable, platy horizon that has been leached of clays and organic matter. Below this is a dark brown to dark yellowish brown horizon of clay accumulation. It contains many well-developed subangular blocky peds that have shiny, clay-coated surfaces. The unaltered subsoil is firm and massive. In Elbow soil profiles, evidence of weak bedding in the parent material is apparent. In Robinson soil profiles, the parent material contains small flecks of coal, soft weathered sandstone and shale particles and reddish brown iron stains. This parent material is usually encountered at about 70 cm and is enriched in calcium carbonate. The surface horizons are strongly acid in reaction, and the subsoil below about 70 cm is neutral to mildly alkaline.

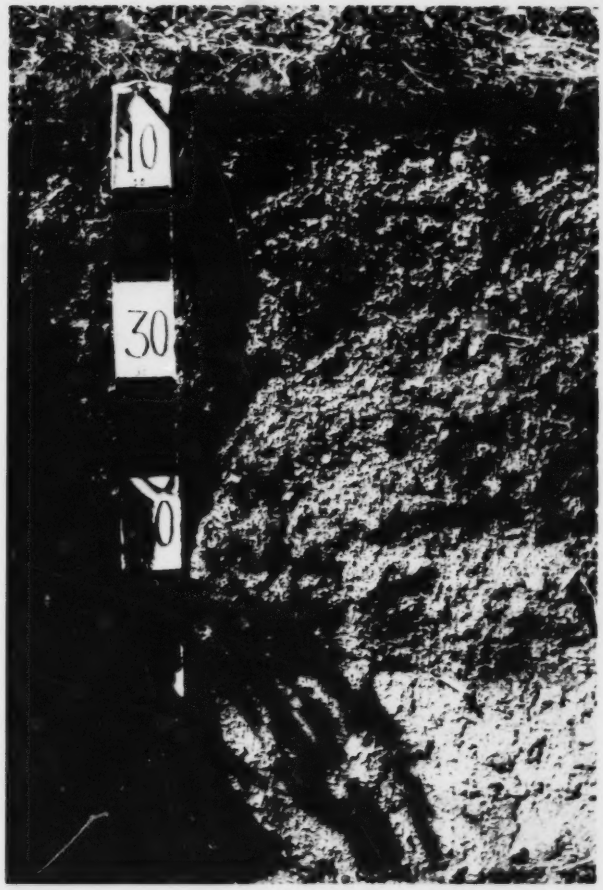



**Plate 23.** Elbow soil

Both soils are moderately well drained, slowly pervious and have a high moisture retention capacity. Surface drainage is slow on level topography, and undrained depressions are common. In steeper areas, where shallow troughs and gullies channel water directly downslope, surface drainage is rapid.

Elbow and Robinson are both classified as Dark Gray Luvisols. Included when mapping, are some soils

in which the dark gray surface horizons are absent or less than 5 cm thick, but are otherwise similar. These are classified as Orthic Gray Luvisols.

**ELRS 1**
This unit is found in valleys and on flat-topped uplands. The landscape is nearly level to gently rolling and contains few irregularities. About 60 percent of the unit is either Robinson or Elbow soil. A further 30 percent is a similar soil that lacks the 5 cm thick dark gray surface horizon. The remainder of the unit consists of Fish Creek soil and widely scattered, wet, clayey soils that are found in depressions.

All of the soils in this unit have high clay contents and most are moderately to strongly leached. The dark gray surface horizon varies from 10 cm thick to non-existent. Because of the high clay contents, most soils in this unit retain moisture strongly, but substantial wetness affects only scattered minor depressions.

Use of ELRS 1 areas is limited by adverse climate and soil properties. The short frost-free period limits agricultural use to forage and pasture. The high clay content of the parent materials can lead to engineering problems arising from high shrink-swell potential, low permeability, low shear strength (slumping hazard) and high natural soil wetness. ELRS 1 areas are generally wooded and are of little productive value except as unimproved pasture and natural grazing areas.

**ELRS 2**
This unit is mapped on nearly level surfaces of bedrock controlled plateaux. A relatively thin veneer of glaciolacustrine sediment overlies till of a similar fine texture throughout the unit. The clay veneer and till together are often only 2 to 3 m thick and overlie a thin deposit of gravel and sand resting on bedrock. About 60 percent of this unit is Elbow and Robinson soil. About 40 percent of the unit consists of similar soils that lack or have less than 5 cm of dark gray surface horizons. Gravelly subsoil variants of the above soils may also form part of the unit.

All of the soils in this unit have high clay contents and are moderately to strongly leached. The dark gray surface horizon varies from 0 to 10 cm thick. A thin veneer of glaciofluvial sand and gravel resting on bedrock underlies most of the unit.

ELRS 2 areas possess limitations imposed by adverse climate, soil texture and subsoil variability. The short frost-free period restricts agricultural use of these areas to pasture and forage. Engineering uses are limited by the high clay content and associated undesirable physical properties of the glaciolacustrine parent material. Further constraints may result from the relatively shallow depth to bedrock or from the presence of a rapidly permeable gravel layer overlying the bedrock. ELRS 2 areas are almost always heavily treed. The predominant species is lodgepole pine, but no commercial use of this resource is evident. The level terrain is frequently exploited for country residential development.

**ELRS 3**
This unit is found on steep, till-covered bedrock controlled slopes. About 50 percent of the unit is Elbow or Robinson soil. About 30 percent consists of similar soils that have less than 5 cm of dark gray topsoil. The remainder of the unit consists of thick, black slopewash soils, wet soils that form in seepage locations, and a few soils that have bedrock within 1 m of the surface.

In this unit, fine clayey till mantles steep, bedrock-controlled slopes. Patches of fine clayey glaciolacustrine parent material may be found anywhere on the slope, but are most numerous in toe slope and crest positions. Soils with less than 5 cm of dark gray topsoil form in occasional densely wooded patches. Bedrock outcrops and shallow lithic soils are found mainly in upper slope positions.

Agricultural use of this unit is limited by its short frost-free season. Steep slopes are an additional limitation where they exceed 15 percent. Most areas are covered by non-commercial forest and are used for woodland grazing. Non-farm uses are limited by high clay content, high plasticity, low permeability, slope instability and, occasionally, by shallow depth to bedrock.

**ELRS 4**
This unit is mapped on a till-mantled glaciofluvial outwash plain. The landscape ranges from nearly level to ridged. About 30 percent of the unit consists of Robinson soil or Elbow soil and about 30 percent consists of similar soils that have less than 5 cm of dark gray topsoil. The remainder of the unit consists of soils that are sandy within 1 m of the surface, poorly drained depressional soils, and some weakly leached, sandy, Connop soil. In this unit, a fine clayey glaciolacustrine or till veneer overlies sandy to coarse loamy, extremely calcareous, glaciofluvial sediments. The veneer varies from several meters thick where the till has been pushed into ridges, to non-existent near the edges of the unit. Over much of the unit, the veneer is 60 to 100 cm thick. Wet soils are found in depressions, which are most frequent in areas of ridged or hummocky topography.

The short frost-free period severely limits agricultural use of ELRS 4 areas. They are forested and are often used for woodland grazing. Non-farm uses are restricted by lack of topsoil, high clay content and high plasticity of the soils formed in the till veneer, and by rapid permeability of the sandy subsoil material. The sandy glaciofluvial sediments are mainly composed of carbonate grains and may, therefore, be unsuitable for use as aggregates.

## Fish Creek (FSH)

Fish Creek is a deep, moderately well-drained, black grassland soil formed on very clayey glaciolacustrine sediments in agroclimatic zone 3H. The sediments range from 1 to 20 m in thickness. Their texture varies considerably, but they always contain a high proportion of clay-sized material. In vertical exposures, large blocks and lenses of till-like material were observed within the clay.

Fish Creek soil is found in narrow valley bottoms and larger glaciolacustrine basins. The topography is mainly undulating to gently sloping with few surface ir-

regularities. Fish Creek sometimes occurs on hummocky or steep topography in complex association with various till soils.

Most areas of Fish Creek soil have been cleared and seeded to pasture. They support a vegetation dominated by introduced smooth brome, timothy, Kentucky blue grass and cinquefoil, rough cinquefoil, pasture sage and sage brush. A scrub vegetation consisting of willow, swamp birch, shrubby and rough cinquefoil, scattered aspen, alder, balsam poplar, wolf willow and the occasional white or black spruce, occurs in the uncleared areas.

Fish Creek soil is affected by local topographic features that produce a unique microclimate. Cold air drains into low-lying areas and increases the frequency of growing season frosts. Surface runoff and groundwater also accumulate and are retained in valley positions. The soil remains cool and moist well into spring; this can delay seeding and early crop growth. Despite these cool, moist conditions, oats and barley have been ripened in most Fish Creek areas. The soil is, therefore, placed in agroclimatic zone 3H, in which the frost-free period is short (60 to 70 days), but hardy, rapidly maturing crops can be ripened. FSH 5 areas are mapped where the frost-free period is definitely too short for successful grain production.

Fish Creek is easily distinguished from other soils of the map area by its dark color, high clay content and lack of stones (plate 24). The surface is thick, black, friable and usually granular. It is sometimes underlain by a light-colored, weakly platy, leached horizon. Beneath this is a dark-colored, blocky horizon of clay accumulation (Bt). Earthworms and earthworm casts are common in both surface and subsurface horizons. The unaltered parent material is found at 50 to 80 cm. It is dark grayish brown to olive brown, has a high clay content and is massive to weakly bedded. Surface horizons are medium acid to neutral in reaction, while subsurface horizons are neutral to moderately alkaline. Fish Creek is moderately well drained, slowly pervious and has high moisture retention. Surface drainage is concentrated in dendritic channels in most mapped areas. Measurements taken at one site in this soil indicate the presence of a water table at about 100 cm deep.

Fish Creek is classified as an Orthic Black. Some similar soils included in Fish Creek soil units are Eluviated Black, Dark Grays, Gleyed Black and Gleyed Eluviated Black.

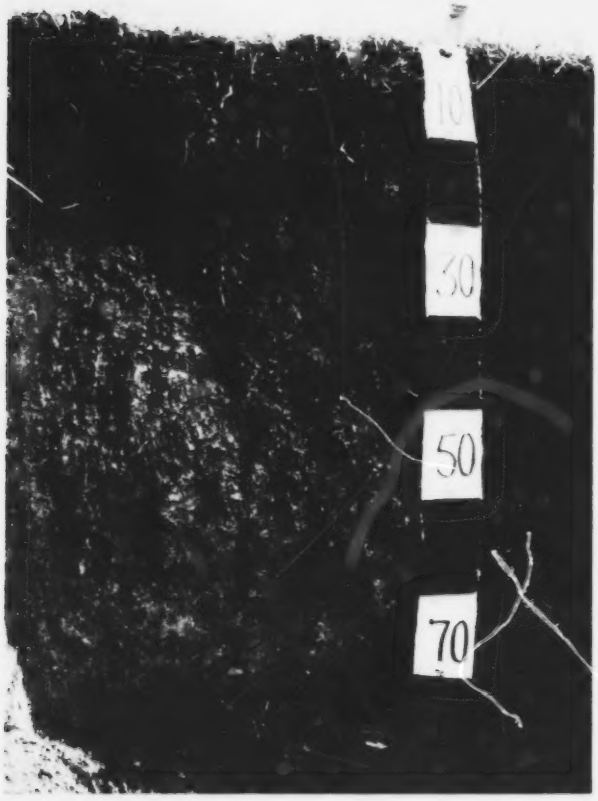



**Plate 24.** Fish Creek soil

**FSH 1**

This unit is mapped on smooth, undulating to gently sloping glaciolacustrine landscapes. It is found along the sides and bottoms of several narrow, northwest-trending valleys in the foothills southwest of Calgary and along the western portion of the Calgary Laking Basin. The fine clayey glaciolacustrine sediments are usually several meters thick and may extend to depths of 20 m. About 65 to 86 percent of the unit consists of Fish Creek soil, the remaining being a similar, but slightly leached soil.

FSH 1 areas possess relatively uniform drainage and soil material properties. They contain very few poorly drained soils. The amount of clay-sized material present in the subsoil is high and may range from 50 to 80 percent.

Agricultural use of FSH 1 areas is limited to those crops that can ripen during the short frost-free season (60 to 75 days). The high clay content of the parent material results in low permeability, high shrink-swell potential, low shear strength (slumping hazard) and high natural wetness (plate 25). These soil properties may adversely affect many engineering uses. Intensive on-site investigation may be required to establish correct construction procedures. FSH 1 areas are almost always cleared. They are used extensively for pasture and forage and considerable acreage is devoted to coarse grain production. Oats and some barley are grown primarily for use as green feed.

**FSH 2**

This unit is mapped on nearly level to slightly hummocky glaciolacustrine landscapes. The sediments range from several to tens of meters thick and have a consistently high clay content. They are found in several narrow, northwest-trending valleys west of Priddis and along the western portion of the Calgary Laking Basin. About 48 to 85 percent of the unit is Fish Creek or similar soils. Wet, clayey Pothole Creek soil forms in shallow depressions covering about 15 to 35 percent of the ground surface.

**Plate 25.** Fish Creek soil slope instability

Growth of crops is limited in FSH 2 units by the short frost-free period (60 to 75 days) and by the occurrence of numerous wet soils. Engineering uses are affected by high clay content, high shrink-swell potential, high natural soil wetness and low shear strength of the parent material, and by the tendency of these values to vary considerably with depth and location. FSH 2 areas are most often used as pasture. A low shrub cover is retained and used as unimproved pasture in some areas. Some oats and barley are grown where topography and drainage constraints are not too severe.

**FSH 3**

This unit is mapped on smooth, undulating to gently sloping glaciolacustrine landscapes. The clayey sediments are continuous at the surface, but grade to till between 80 cm and several meters depth. The underlying till appears similar to that found in adjacent morainal areas, but it often has a higher than normal clay content, higher plasticity and is more variable. FSH 3 areas consist mostly of Fish Creek soil (50 percent). They differ from FSH 1 in that till underlies the glaciolacustrine sediments relatively near to the surface and often forms the subsoil parent material. Only a few wet soils (Pothole Creek) are found in FSH 3 areas.

The surface soil conditions in FSH 3 areas strongly resemble those described for FSH 1. The unit is moderately well drained throughout and contains very few poorly drained soils. The black surface horizon (Ah) is continuous and is rarely less than 15 cm thick. Subsoil properties such as coarse fragment content, plasticity and permeability can vary widely depending upon whether till or glaciolacustrine clay forms the parent material.

The short frost-free period (60 to 75 days) limits the choice of crops that can be grown in this unit. High clay content, low permeability and high plasticity adversely affect many potential non-farm uses. Numerous road embankment failures attest to the low slope stability of these materials. Unpredictable variation in subsoil properties may necessitate detailed on-site investigations when planning for engineering uses. FSH 3 areas are used extensively for pasture and forage, but considerable acreage is devoted to coarse grain production. Grains are usually harvested for green feed.

**FSH 4**

This unit is mapped on nearly level to slightly hummocky glaciolacustrine landscapes. Irregularities in the surface topography give rise to numerous scattered depressions in which wet clayey Pothole Creek soil forms. The veneer of glaciolacustrine clay varies in depth and is often less than 1 m thick. The underlying till is similar in appearance to adjacent morainal deposits, but is more variable and has a higher clay content and greater plasticity than normal. About 50 percent of this unit is Fish Creek soil and about 30 percent consists of similar soils formed on till or having till within 1 m of the surface. About 20 percent of the unit is poorly drained Pothole Creek soil.

The presence of numerous wet soils causes a wide variation in soil wetness within the unit. Variations in subsoil physical properties are influenced by whether till or glaciolacustrine clay is encountered at depth.

Crop growth is limited by the relatively short frost-free period (60 to 75 days) and by the occurrence of numerous wet spots. Engineering uses may be adversely affected by the high plasticity, high clay content, low permeability and variability of the surface and subsurface geologic materials. Slope stability problems common to all Fish Creek units also occur in FSH 4. FSH 4 is often the least intensively used of the FSH units. It may retain its original low shrub cover and be used for unimproved pasture. Some FSH 4 areas have been cleared and seeded to pasture, forage or coarse grains, but cultivation is frequently restricted by the scattered wet soils.

**FSH 5**

This unit is mapped on smooth, undulating to gently sloping glaciolacustrine landscapes in areas where the short frost-free period is severely limiting to agriculture. It is found in several narrow, northwest-trending valleys in the foothills west of Calgary, adjacent to the Bow Crow Forest Reserve. The glaciolacustrine parent material may exceed 20 m in depth and is consistently greater than 1 m thick. FSH 5 areas contain about 50 percent Fish Creek soil and about 40 percent Elbow soil, which has a light-colored leached horizon (Ae) underlying its black surface layer (Ah), as shown on plate 26. The unit also contains a few scattered areas of wet Pothole Creek soil.

The degree of soil leaching varies within this unit, with light-colored subsurface horizons developing in some locations. Occasionally, lighter-colored surface soils occur on knolls where erosion or cultivation has removed the original dark surface. The unit is mostly well drained and contains only a few poorly drained depressions.

Crop growth is severely limited by the very short frost-free season. There may be as few as 15 days between the last spring and the first fall frost. As with other Fish Creek units, the parent material properties related to high clay content may adversely affect many non-farm uses. Of special note, are low permeability,

low slope stability, high shrink-swell potential and stickiness of the clayey subsoil. Most FSH 5 areas are in permanent pasture or are used for forage production.

## Happy Valley (HPV)

Happy Valley is a weakly developed, rapidly drained, black to dark brown grassland soil formed on sandy to coarse loamy glaciofluvial sediments in agroclimatic zones 1 and 2H. The sediments range from one to several meters in thickness. They are almost always very strongly calcareous. Their texture varies considerably, but they always contain a high proportion of sand and silt-sized material. Stone content is generally low, but a few areas have been mapped that contain lenses and beds of gravel.

This soil is found on outwash plains, terraces and deltas adjacent to major glacial outwash channels. The land surface ranges from gently sloping to hummocky. Some Happy Valley units occur on irregular ridges, which may be eskers or dunes.

The natural vegetation is mixed prairie grasses. The main species are spear grass, wheatgrasses, porcupine grass, rough fescue, blue grasses and June grass. Few trees grow on this soil due to its low moisture-holding capacity. Happy Valley is mapped in agroclimatic zones 1 and 2H. Rainfall (400 mm per year) would be adequate for most crops if the soil were not so rapidly drained. The frost-free period may range from 75 to more than 100 days.

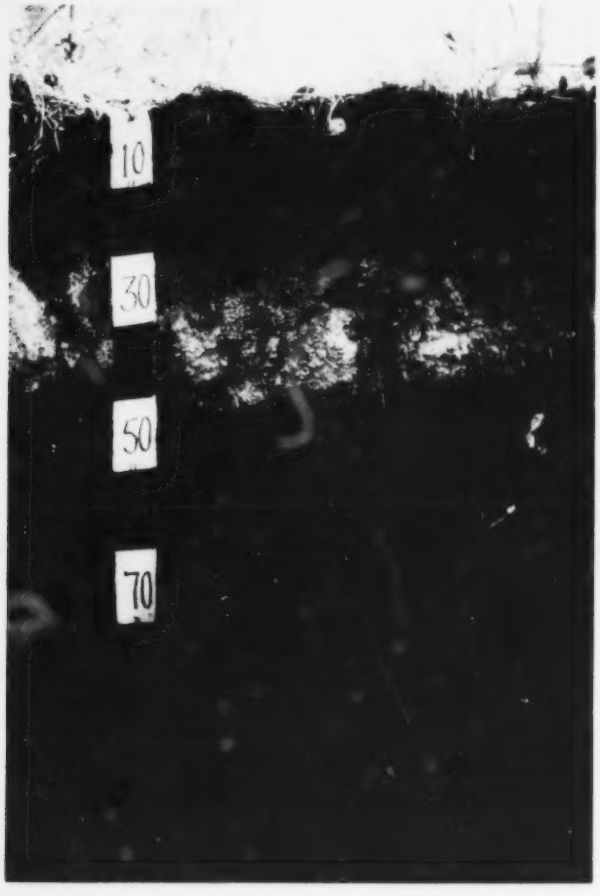



**Plate 26.** Eluviation characteristic of FSH 5 soil unit

**Plate 27.** Profile of a Rego Black soil included in Happy Valley soil group

Happy Valley soil is subject to erosion by wind. Horizon development is weak and reflects successive periods of erosion and deposition (plate 27). The sandy surface horizon often contains a mixture of dark brown to dark grayish brown eroded topsoil and light gray to light brownish gray subsoil. In places, these materials form distinct layers, but in other locations, they are completely mixed. The resulting topsoil is usually much lighter colored than that of surrounding non-eroded soils. Subsurface horizons, if present, are weakly expressed and contain free lime. The unaltered parent material occurs from 15 to 40 cm. It is light gray when dry and dark grayish brown when moist. It is often bedded and contains only occasional cobble-sized stones. The subsoils always have a low clay content, but the proportions of sand and silt vary greatly. Both surface and subsurface horizons are moderately alkaline in reaction. Happy Valley is rapidly drained, rapidly pervious and has a low moisture-holding capacity. Most precipitation rapidly infiltrates the soil.

Happy Valley is classified as a Rego Black. Many profiles require the further recognition of an eroded phase. Included with this soil when mapping are some Orthic Regosols, Calcareous Blacks and Orthic Blacks.

### HPAD 1

This unit is found on nearly level to gently inclined morainal landscapes that are covered by a veneer of coarse loamy glaciofluvial material and, in some locations, by scattered patches of fine silty loess. About 40 percent of the unit is rapidly drained, weakly developed Happy Valley soil. About 20 percent is well-drained Academy soil and about 20 percent is weakly developed, silty Eastbow soil. The remainder of the unit consists of variable amounts of Midnapore or Rockyview soils.

HPAD 1 is mapped where relatively thin deposits of sandy to silty glaciofluvial and aeolian material mantle

most of the till landscape. The upper meter is, therefore, highly variable in texture, but fairly uniform-textured till is encountered within 50 to 150 cm of the surface throughout most of the soil unit.

Use of this unit is limited primarily by the sandy to silty nature of the surface soils. Slight to moderate limitations to agricultural use arise due to soil droughtiness and erosion. Non-farm uses may be limited by rapid permeability or high silt content. HPAD 1 areas are cultivated mainly to wheat, barley or canola, or left in pasture. The glaciofluvial veneer is too thin and silty to provide a good source of sand.

**HPAD 3**

This unit is mapped on hummocky topography where the parent material is a mixture of fine loamy till and sandy to coarse loamy glaciofluvial sediments. About 40 percent of the unit is Happy Valley soil. A further 40 percent consists of well to poorly developed Academy or Sharp Hill soils. The remainder of the unit is mostly silty Eastbow soil.

The parent material of this unit varies from sandy to fine loamy. Individual knobs may be entirely till or all sandy. Some knobs are a complex mixture of both materials. There does not appear to be any pattern to the distribution of the two materials. Erosion and rapid surface runoff result in numerous eroded or weakly developed profiles within this unit.

Agricultural limitations to use of this unit arise from adverse topography, droughtiness and, to a lesser extent, erosion. Engineering users may be constrained by steep slopes, rapid permeability, high silt content or erosion. Most HPAD 3 areas are used for improved or unimproved pasture. Some areas have been developed for country residences.

**HPAD 4**

This unit is mapped on moderate to steep slopes adjacent to meltwater channels and stream valleys. It contains a mixture of sandy glaciofluvial, silty aeolian and loamy till parent materials. About 50 percent of the unit is sandy Happy Valley soil. About 30 percent is either well-developed Academy or poorly developed Sharp Hill soil on till. The remainder of the unit is mostly silty Eastbow soil.

This unit consists of slopes cut into till that have an irregular cover of sandy to silty material, often appearing to have slumped over the hillslope from overlying deposits. The silty materials are likely a result of late stage reworking by wind of the near surface sandy deposits. Most soils in this unit are weakly developed, and thin or eroded profiles are common. Surface runoff is rapid due to the steep slopes, and both infiltration and water-holding capacity are low.

Agricultural use of this unit is limited primarily by steep slopes and, to a lesser extent, by droughtiness or erosion. Non-agricultural uses are also constrained by steep slopes, rapid permeability over parts of the unit, variable subsoil textures, high silt content of some soils and susceptibility to erosion. This unit covers only a few small areas and appears to be left in its native state or used for pasture.

**HPSC 1**

This unit is mapped on glaciofluvial fans, terraces and abandoned channels that contain a mixture of sandy and gravelly soils. About 60 percent of the unit is sandy Happy Valley soil or somewhat better-developed Midnapore soil. About 30 percent of the unit consists of poorly sorted, gravelly Strathcona soil. Silty Eastbow soil constitutes most of the rest of the unit.

HPSC 1 areas are mostly sandy, but contain discrete channels, bars or fans of gravel that were either laid down at the same time as the sand or deposited later as a result of erosion from gravel deposits located in higher landscape positions. Soils within this unit are generally thin and weakly developed. Drainage is rapid and water-holding capacity is low.

When cleared, this unit is used primarily for pasture. Several areas remain wooded. Agricultural use is limited by droughtiness, stoniness and erosion. Some non-farm uses are limited by rapid permeability and erosion. Some HPSC 1 areas have been exploited as sources of sand or gravel, but the materials are often quite poorly sorted and may contain a high proportion of fine-sized particles.

**HPV 1**

This unit occurs on smooth, nearly level to undulating glaciofluvial landforms. Patches of silty loess form a thin veneer over portions of the surface. About 50 percent of the unit is sandy, poorly developed Happy Valley soil and 20 percent is better-developed Midnapore soil. Silty Eastbow soil constitutes most of the remainder of the unit.

Most of this unit consists of sandy to coarse loamy glaciofluvial parent materials greater than 1 m thick. Portions of the surface are quite silty due to wind reworking. Most soils are thin and poorly developed. Erosion of topsoil is commonly in evidence. The unit is uniformly rapidly to well drained.

Agricultural use of this unit is limited by droughtiness and erosion. Some non-farm uses may be adversely affected by rapid permeability, high silt content of the Eastbow soils and susceptibility to erosion. Presently, most HPV 1 areas are cultivated to wheat or barley, or kept in pasture. Reduction in growth due to erosion and droughtiness is often apparent. The parent material in these areas appears to contain too much silt and clay to be suitable as a source of sand.

**HPV 2**

This unit is mapped on inclined sloping or ridged glaciofluvial landscapes. The parent material is dominantly sandy to coarse loamy glaciofluvial, but the surface is often covered with a thin silty aeolian veneer. About 50 percent of the unit is sandy Happy Valley soil and about 20 percent is silty Eastbow soil. The remainder of the unit consists of sandy to coarse loamy soils which are either completely eroded or are more strongly developed than Happy Valley.

This unit is a relatively thick and uniform glaciofluvial deposit. Most profiles are thin and quite a few are completely eroded. Most of the surface has been affected to some degree by wind sorting.

Agricultural use of this unit is limited by steep

slopes, droughtiness and erosion. Some non-farm uses are also constrained by rapid permeability, steep slopes or erosion. Most HPV 2 areas are left in pasture or used for hay, but some have been cultivated for wheat or barley production.

**HPV 3**
This unit is found on hummocky, glaciofluvial landscapes. The parent material is dominantly sandy to coarse loamy glaciofluvial, but the surface is often covered with a thin silty aeolian veneer. About 60 percent of the unit is sandy Happy Valley soil and about 20 percent is silty Eastbow soil. The remainder of the unit consists of well-developed or completely eroded soils developed on the same parent material as Happy Valley.

Most of this unit consists of a fairly sandy parent material with a thin, overlying silty veneer. Soil profiles are mostly thin and weakly developed, and are often eroded. The hummocky topography, which results in slope changes, is one of the main causes of variability within the unit.

Agricultural use is limited primarily by adverse topography and, to a lesser extent, by droughtiness and susceptibility to erosion. These same limitations also affect non-farm uses. Only a few HPV 3 areas were mapped; they were used as uncleared or cleared pasture.

## Highwood (HIW)

Highwood is a rapidly drained, weakly developed, black grassland soil. It forms on sandy to coarse loamy glaciofluvial or recent fluvial floodplain deposits. The sediments are several meters thick and generally overlie glaciofluvial gravels. This soil is found on smooth, level terraces adjacent to the Bow and Highwood rivers east of Calgary.

Most areas of Highwood soil are cleared for cultivation, but the original vegetation is thought to have consisted of grasses such as spear grass, blue grama and wheatgrasses and low shrubs. The soil is mapped primarily within agroclimatic zone 1, where precipitation averages 400 mm per year and the frost-free period exceeds 90 days.

A representative profile of Highwood soil has a calcareous, weakly structured, loamy, black surface horizon about 20 cm thick. This is underlain directly by unaltered, strongly calcareous, sandy to coarse loamy parent material. Both surface and subsurface horizons are moderately alkaline in reaction. Highwood soil is rapidly drained, rapidly pervious and has a low to medium moisture-holding capacity. Surface drainage is minimal, as most precipitation rapidly infiltrates the soil.

Highwood is classified as a Rego Black Chernozemic soil. It is similar to Happy Valley in classification and texture, but has a thicker, more even topsoil layer and is less affected by erosion. Included with Highwood when mapping are some very weakly developed soils classified as Orthic Humic Regosols, some more strongly developed Orthic Black soils and some soils which have gravelly subsoils.

**HIBO 1**
This unit is mapped on nearly level to inclined glaciofluvial terraces. The parent material consists of a variable thickness, sandy to coarse loamy veneer overlying gravel. About 40 percent of the unit is sandy Highwood soil and 30 percent is a similar soil that has gravel within 1 m of the surface. About 20 percent consists of gravelly Bow Valley soil and about 10 percent consists of more strongly developed soils found on the same parent material as Highwood soil.

The major variability in this unit relates to the thickness of the overlying veneer and thus the depth to gravel. Gravel is within 1 m of the surface over much of the unit, but there are also deeper deposits of sandy surface veneer. The soils have a weakly developed, but uniformly thick plough layer, which is usually weakly expressed and is often calcareous to the surface.

This unit has moderate limitations for dryland agriculture, arising principally from rapid permeability and droughtiness. Many HIBO 1 areas are irrigated and used for forage production, grain crops or intensive operations such as tree farms. Non-farm uses may be limited by rapid permeability, possible groundwater contamination hazard and stoniness.

**HIW 1**
This unit is found on nearly level to inclined glaciofluvial terraces. The parent material is sandy to coarse loamy glaciofluvial. About 40 percent of the unit is Highwood soil and 30 percent is a very similar soil classified as an Orthic Humic Regosol. About 20 percent consists of deep, well-developed Midnapore soil, and a small portion of the unit consists of silty Eastbow soil.

The sandy to coarse loamy parent material of this unit averages 2 to 4 m in thickness and overlies gravel. All soils within the unit are quite similar, and all have a relatively thick, weakly structured, dark-colored surface layer overlying unaltered to slightly altered subsoil.

Agricultural use of this unit is limited slightly by rapid permeability and droughtiness. Many HIW 1 areas, however, are irrigated and produce good yields of alfalfa or barley. Several large areas have developed as tree farms. The unit presents few limitations for most non-farm uses except those which are constrained by rapid permeability.

## Indus (IND)

Indus is a poorly drained, deeply leached, black soil formed in wet depressions on till in agroclimatic zone 1. The till is fine loamy in texture, contains few coarse fragments, is strongly calcareous and is of Continental origin. It is frequently overlain by a veneer of locally eroded material that has washed into the depression. Indus is most often mapped as a component soil in other well-drained soil units. Some areas, however, are large enough to be recognized and mapped separately. The land surface in these areas is level to depressional and often leads to ponding of runoff water.

Areas of Indus soil support a growth of grasses such as reed grass (*Calamagrost* spp.), manna grass

(*Glyceria* spp.), blue grasses, slough grass (*Beckmannia syzigachne* Steud. Fern.) and hair grass (*Deschampsia caespitosa* L.J. Beauv.). The depressions are frequently surrounded by rings of willow, aspen or balsam poplar. This soil is mapped in agroclimatic zone 1. It possesses a microclimate somewhat different than that which typifies the zone. The accumulation and retention of water in depressions increases the amount of available moisture above that which is normally expected. The moist conditions delay warming of the soil in the spring, and the depressional landscape position increases the risk of frost. Consequently, the growing season may be shorter than generally predicted for the zone.

A representative profile of Indus soil has a thick black surface horizon that contains abundant organic matter. It is underlain by several platy horizons, which range from very dark to light gray in color, depending upon the extent to which they have been leached. The leached zone may extend below 50 cm in depth and usually has prominent mottles that indicate periodic wetness. It overlies a strongly structured, prominently mottled horizon of clay accumulation, which grades to a mottled parent material at depths of from 90 to 120 cm. Permanently moist conditions are maintained in Indus soil due to slow infiltration of subsurface and surface runoff water. Some areas of permanently ponded water occur where a high water table restricts downward infiltration.

Indus is classified as a Humic Luvic Gleysol. Included with this soil when mapping are some Gleyed Black Solods, Gleyed Blacks and Orthic Humic Gleysols. Some wet areas may contain both non-saline Indus soil and saline Balzac soil.

**IND 1**

This unit is mapped in wet depressions of the morainal landscape east of Calgary, which are not strongly affected by the discharge of saline groundwater. IND 1 areas consist almost entirely of Indus soil. They may contain small areas of better-drained soils, mostly Delacour, which are usually located around the outside of depressions.

The degree of soil wetness in IND 1 areas may vary from periodic saturation to more or less permanent ponding. This unit is otherwise quite uniform. The till parent material has a narrow textural range and a low to moderate content of soluble salts. Most soil profiles within the unit conform to the representative description given previously for the soil.

Wetness and flooding hazard are the main factors limiting use of IND 1 areas. If these areas dry early in the spring, they may be successfully cultivated. They are poorly suited for most non-farm uses. Areas large enough to be mapped as IND 1 are usually not cultivated and remain unused. Smaller areas of Indus soil within dominantly well-drained units are often cultivated, despite problems caused by wetness.

**IND 2**

This unit occurs in depressional portions of undulating to slightly hummocky morainal landscapes. The depressions are not affected by discharging saline groundwater. Rather, they appear to be sites of slow, local groundwater recharge. About 60 percent of the unit is poorly drained Indus soil, and the remainder is better-drained Delacour or similar soils.

The degree of soil wetness varies more widely in this unit than in IND 1. Better-drained soils occur on the numerous slightly elevated knolls. Many IND 2 areas also contain patches of silty loess, which is often found in the hollows and depressions.

Wetness and flooding hazard limit the agricultural use of large portions of IND 2 areas. Use of the better-drained soils of this unit is also constrained by the disruptive effect of the numerous wet soils. IND 2 areas can be cultivated, or are used for pasture or hay. Most non-farm uses of IND 2 areas are limited by soil wetness and flooding hazard as well.

## Leighton Centre (LTC)

Leighton Centre is a deep, well-drained, dark gray forested soil formed on till in agroclimatic zone 3H. The till is fine loamy in texture, strongly calcareous, contains 5 to 10 percent coarse fragments, and is of mixed Continental and Cordilleran origin. Leighton Centre soil occurs on nearly level to steeply sloping, till-mantled bedrock highs and ridges. The till varies from one to several meters in depth and overlies sandstone bedrock. This soil is found most frequently on north- and east-facing slopes, which are cooler, moister and more heavily treed than adjacent south- and west-facing slopes.

Most areas of Leighton Centre are forested. The dominant trees are aspen, balsam poplar and white spruce. Typical shrubs include willow, alder, saskatoon and gooseberry. The relatively open understory contains paintbrush, fireweed, geranium, vetch, lupine, nettle, cow parsnip, clematis, Soloman's seal, dogwood, bunchberry, meadow rue, violet, columbine, strawberry, grasses and some mosses.

Leighton Centre is mapped primarily within agroclimatic zone 3H. Precipitation is adequate for most crops and averages about 470 mm per year. The frost-free period is normally between 60 and 75 days, and represents a moderate agricultural limitation. Areas of Leighton Centre soil on protected, north-facing slopes within agroclimatic zone 2H are assumed to have an aspect-controlled microclimate, similar to that defined for zone 3H.

A representative profile of Leighton Centre soil has a thin, black surface mat of relatively poorly decomposed leaf litter. This is underlain by a black to dark gray, humus rich, mineral horizon which is more than 5 cm thick. A light-colored, platy horizon, leached of organic matter and clay, is usually present near the surface. It overlies a dark brown to dark yellowish brown, moderately structured zone of clay accumulation. Dark grayish brown to light gray unaltered parent material containing free lime begins between the 45 and 80 cm depth. When this soil is ploughed, the surface organic and mineral horizons are mixed. The resulting dark brown plough layer obscures the original appearance of the soil and makes accurate classification difficult. This soil is well to moderately well drained, moderately

pervious and has adequate moisture retention. Since it occurs most frequently on steep slopes, most surface drainage is very rapid and follows shallow troughs and gullies that lead directly downslope.

Leighton Centre is classified as a Dark Gray Luvisol. There are some associated soils that do not have a strongly developed zone of clay accumulation (Bt), and are, therefore, classified as Eluviated Eutric Brunisols. These may form where rapid surface runoff limits infiltration and leaching, or where steady downslope movement of soil material disrupts normal profile development. Concentration of eroded topsoil in draws, gullies and toe slopes gives rise to some soils with abnormally thick black surface horizons, which may be classified as 'Cumulic' Black Chernozemics or Cumulic Humic Regosols. Those soils, which are similar to Leighton Centre but have less than 5 cm of black topsoil, are classified as Orthic Gray Luvisols.

**LTC 1**

This unit is most often found on north- and east-facing hillsides in the foothills and uplands south and west of Calgary. The slopes are usually smooth and steep and are controlled by the underlying sandstone bedrock. LTC 1 unit consists mostly of Leighton Centre and similar dark-colored forested soils (40 percent). It contains some soils with black surface horizons less than 5 cm thick (20 percent), and scattered soils formed in thick accumulations of black slopewash.

The soils in this unit vary mainly in the thickness and color of their surface horizons and in the degree of leaching as indicated by the subsurface horizon of clay accumulation. Over most of the unit, the surfaces underlying the organic litter mat are dark gray. Dark-colored surface horizons less than 5 cm thick form in the more heavily treed locations, and thick accumulations of black topsoil are sometimes found in draws, gullies and along toe slopes. The degree of leaching is not uniform throughout the unit, but varies due to changes in vegetative cover, amount of downslope creep and infiltration of runoff water. The parent material within this unit is consistently till, but certain features of the till may vary. On steep slopes or where bedrock is close to the surface, material derived from the underlying sandstone is often incorporated into the till. Downslope soil creep mixes angular sandstone flags and weathered sandstone into the till and produces a sandier, more stony parent material than usual.

Agricultural use of LTC 1 areas is limited mainly by climate, adverse structure and steep slopes. The climate limitation arises from a moderately short frost-free period (60 to 75 days), which restricts the choice of crops that can be successfully grown. Adverse structure refers to the absence of a substantial layer of topsoil and to the tendency of the platy, light-colored leached horizon to form a crust when cultivated. The crust can restrict seedling emergence and reduce crop yields. Steep slopes commonly form the most severe limitation to both farm and non-farm use. Many engineering uses are also limited by the presence of bedrock within a few meters of the surface. Most LTC 1 areas are steeply sloping and forested. No commercial use of the forest was observed, but many areas are used for unimproved woodland grazing.

**LTC 2**

This unit is mapped on nearly level to gently rolling surfaces that occur on flat-topped, till-mantled, bedrock uplands south and west of Calgary. The till is always greater than 1 m thick and averages 2 to 3 m in depth. About 50 percent of this unit consists of dark gray Leighton Centre soil and 20 percent is a similar soil that has less than 5 cm of dark gray topsoil. Also included is some deep, well-drained Dunvargan soil and scattered patches of poorly drained DeWinton soil.

The soils in this unit vary mainly in the thickness and color of their surface horizons. Ploughing of most LTC 2 areas has resulted in a surface plough layer that contains mixed material from several original horizons. Little variation in soil wetness is observed within this unit, and it is assumed to be almost entirely well drained.

The relatively short frost-free period (60 to 75 days) limits agricultural use of LTC 2 areas. Surface crusting and absence of a thick topsoil layer contribute to an adverse structure limitation over portions of LTC 2 areas. Slopes are rarely greater than 10 percent and, therefore, seldom affect the agricultural rating of this unit. This unit presents few constraints to most non-farm uses. Many LTC 2 areas have been cleared and broken. They are most often used for pasture or forage production. Production of alfalfa and other hay crops is favored by the adequate rainfall and good moisture retention characteristics of the soil.

## Lloyd Lake (LLK)

Lloyd Lake is a deep, well-drained black grassland soil formed on glaciolacustrine sediments in agroclimatic zone 2H. The sediments range from fine silty to fine clayey in texture and are from 1 to >20 m deep. They are distinguished by their high content of silt sized material and generally low sand content (plate 28). They are strongly calcareous, rarely contain any coarse fragments and are weakly bedded to massive.

Lloyd Lake soil is found in valleys and basins south and west of Calgary and on glaciolacustrine terraces along the Bow Valley between Cochrane and Calgary.

**Plate 28.** Lloyd Lake soil

Generally, the surface topography is nearly level to gently undulating. More-steeply sloping topography occurs between terraces and in places where only a thin veneer of glaciolacustrine sediment overlies till slopes.

Most areas of Lloyd Lake soil are presently cultivated. The native vegetation is characteristic of the forest-grassland transition zone. Fescue, Hooker's oat grass (*Helictotrichon hookeri* Scribn. Henr.), porcupine grass and June grass, and other grasses predominate and groves of aspen poplar, willow and alder form in protected areas, on north- and east-facing slopes and in moist depressions. Lloyd Lake is mapped primarily within agroclimatic zone 2H. Rainfall is generally adequate and averages 400 mm per year, but a slight frost hazard exists for some grain crops. The frost-free period is estimated to be between 75 and 90 days. It may be slightly shorter for Lloyd Lake soils found at the western limits of the map area or in valley bottoms subject to cold air drainage.

A representative profile of Lloyd Lake soil has a black, friable, surface horizon that is seldom less than 15 cm thick. This is underlain by a weakly structured, dark yellowish brown oxidized horizon. A zone of lime accumulation occurs between 30 and 50 cm depth and grades into unaltered parent material at about 60 to 90 cm. The parent material is dark grayish brown when moist and light brownish gray to light gray when dry. Surface horizons are mildly alkaline in reaction, and subsurface horizons are moderately to strongly alkaline. Lloyd Lake is well drained, moderately pervious and has a medium moisture retention capacity. Measurements taken at one site show the existence of a water table at a depth of about 150 cm. Surface drainage is usually integrated and adopts a dendritic pattern. Lloyd Lake is classified as an Orthic Black. Included when mapping this soil are some similar soils that are classified as Calcareous Black and Rego Black.

**LLK 1**

This unit is mapped on smooth undulating to gently sloping glaciolacustrine landscapes. It is found on terraces bordering the Bow Valley, in several broad valleys northwest and southeast of Lloyd Lake and throughout the eastern portion of the Calgary Lake Basin. The sediments are usually several meters thick and may extend to a depth of 10 m or more. About 30 to 55 percent of this unit consists of Lloyd Lake soil, and about 18 to 40 percent is similar weakly developed Bearspaw soil. Gleysols and other contrasting soils are present in only minor amounts.

The sediments vary widely in texture below the profile depth. Some deposits are very sandy at several meters, while others are predominantly heavy clay. The subsoil always has a high content of silt-sized material (50 to 80 percent) and usually contains from 20 to 40 percent clay. Soil profiles vary mainly in the degree of development of the subsurface oxidized horizon. Where lime has been incompletely removed or reintroduced, this horizon is weakly developed or absent. The unit is uniformly well drained, but there is often a water table at a depth of about 150 to 200 cm.

The relatively short frost-free period (75 to 90 days) imposes a slight limitation on the choice of crops that can be grown in this unit. It is not suitable for growing wheat or other late-maturing crops on a continuing basis. The soil itself presents no serious limitations to agricultural use. Gentle slopes and good drainage make LLK 1 suitable for most non-farm uses. High silt content, high rate of frost heave, medium plasticity and medium permeability may adversely affect some engineering uses. Considerable on-site inspection may be required in some cases, in order to compensate for the high natural variability of the parent material. LLK 1 areas are extensively cultivated. Common crops are barley, rye, oats and canola. Some areas are used for forage, hay or pasture.

**LLK 2**

This unit occupies lower, wetter portions of the glaciolacustrine landscape than LLK 1. It is mapped mainly around Lloyd Lake south of Calgary. About 40 percent of the unit is silty, well-drained Lloyd Lake soil and about 40 percent consists of imperfectly drained soils which have been slightly to moderately influenced by saline groundwater. The remaining 20 percent is mainly poorly drained, saline Balzac soil. The wet soils are not always confined to scattered small depressions in the landscape. The unpredictable distribution is often controlled by subsurface features such as seepage or a high water table. The high water table and slight salinity may be due to the presence of bedrock within a few meters of the surface.

The high textural variability characteristic of Lloyd Lake soil is retained in this unit. In addition, the degree of soil wetness and salinity vary more than in LLK 1. A water table is often found within 1.5 m of the surface.

Agricultural use of this unit is restricted by the short frost-free period, by the occurrence of some wet, slightly saline soil and by the low, wet landscape common to the entire unit. Soils remain cool and moist late into the spring, and frost is likely to occur frequently in these low areas. Non-farm uses may be limited by high silt content and shallow depth to water table, by high frost heave potential, by the medium plasticity and medium permeability of the parent material, by the relatively shallow depth to bedrock (1 to 2 m) and by the uneven distribution of soil wetness and salinity. The few areas of mapped LLK 2 are used mostly for pasture and forage.

**LLK 3**

This unit occurs on gentle to strong glaciolacustrine slopes that are usually underlain by till within 1 to 2 m of the surface. The till appears similar to that found in adjacent morainal areas, but it often has a higher than normal clay content, higher plasticity and is more variable. A few LLK 3 areas are mapped on steep slopes connecting different levels of glaciolacustrine terraces along the sides of the Bow Valley. These particular areas have thick deposits of glaciolacustrine material and do not contain any till in their subsoil. About 40 percent of the unit is silty Lloyd Lake soil and 30 percent is thin, weakly developed Bearspaw soil. The remainder of the unit consists of soils that have till

parent material within 1 m of the surface or are affected by the accumulation of slopewash.

This unit is uniformly well drained, as most rainfall is removed by surface runoff. The runoff is usually channeled into draws and shallow gullies that lead directly downslope. Available soil moisture is concentrated in these draws and is often lacking in intervening portions of the unit. Topsoil is often eroded by surface flow and tends to accumulate in the draws and along the toe slopes of the unit. Soil profiles are shallow and weakly developed on the steeper portions of the hillsides, and thicker where runoff water and eroded topsoil concentrate. Various properties of the subsoil change, depending on whether till or glaciolacustrine silty clay forms the soil parent material.

Steep slopes are the major limitation to use of LLK 3 areas. Agriculture is initially limited by the length of the frost-free period (75 to 90 days) and is further restricted by steep slopes. The slopes result in rapid runoff of precipitation, topsoil erosion and low available soil moisture, which combine to further limit the agricultural potential of this unit. Some non-farm uses are affected by steep slopes, high silt content in the soil, medium plasticity and permeability, and variable subsoil composition and properties. Areas of LLK 3 with slopes less than 9 percent are most often cultivated or used for pasture. They differ little from LLK 1 areas except that the existence of till in their subsoil can affect some non-farm uses. LLK 3 on slopes greater than 9 percent is usually left in grass and used for grazing.

**LLK 4**

This unit is mapped on the lowest glaciolacustrine terraces bounding the Bow River. It differs from LLK 1 in that the fine silty parent material is only 1 to 2 m thick and overlies gravel. The fine silty sediments form a gently sloping wedge, which is several meters thick at the sides of the valley and becomes thinner towards the river. Glaciofluvial outwash gravel underlies the glaciolacustrine sediments and, in places, forms the soil parent material. About 50 percent of this unit consists of Lloyd Lake soil and 30 percent is similar, weakly developed Bearspaw soil. The remainder of the unit consists of soils that have gravel within 1 m of the surface or are developed entirely in gravel (Bow Valley).

LLK 4 areas vary little in their distribution of soil moisture and generally display a limited textural range. The depth to underlying gravel varies, becoming thinner towards the river.

Agricultural use is limited by the relatively short frost-free period. The valley bottom location of these soils makes them especially susceptible to unseasonable frosts caused by cold air drainage. The frost-free period is estimated to be 75 days or slightly less. The unit, therefore, has a climate which is marginal to agroclimatic zones 2H and 3H. There are no serious soil-related limitations to crop production. Slopes are long, gentle and smooth, and topsoil depth, moisture-holding capacity and fertility are adequate. The proximity of the Bow River provides a ready source of irrigation water. Some uses such as reservoir construction or septic filter field installation may be adversely affected by the presence of rapidly permeable gravel just below the normal profile depth. There are few limitations for most other non-farm uses. LLK 4 areas are frequently used for forage production. When irrigated, they may produce two cuttings of alfalfa annually.

## Mesa Butte (MSB)

Mesa Butte is a shallow, well-drained, black soil formed on colluvial and residual material overlying bedrock in agroclimatic zone 5H. The parent material displays a wide range in properties depending on the nature of the underlying bedrock and the amount of downslope movement. It is generally non to weakly calcareous, fine silty to fine loamy in texture and contains numerous angular, coarse fragments derived from the underlying bedrock.

Mesa Butte is found on the steepest portions of bedrock ridges in the foothills southwest of Calgary. It is mapped along the crests of several northwest-trending ridges and on a few very strongly sloping, south-facing hillsides. The parent material is derived mostly from the underlying bedrock and often consists almost entirely of partially weathered, angular sandstone and shale fragments. It may also contain some material originally deposited as till, but subsequently altered by mixing with residual debris during downslope movement. The surface material is usually less than 1 m thick and overlies hard, unweathered bedrock.

Mesa Butte soil is found under a vegetation community dominated by grasses such as rough fescue, wheatgrasses and June grass. One such community forms on steep south-facing slopes in areas that are otherwise forested. A similar community develops in the montane environment, which is found at the tops of those ridges which extend above 1500 m elevation. These areas are characterized by a very open tree cover consisting mostly of lodgepole pine and including some aspen and white spruce. The understory is dominated by grasses such as wheatgrasses, interior blue grass (*Poa interior* Rydb.), Idaho fescue (*Festuca idahoensis* Elmer) and June grass.

The climate associated with Mesa Butte soil is highly variable and is difficult to fit into an established category. The soil is mapped within agroclimatic zone 5H, which is defined as having a frost-free period of less than 60 days and adequate rainfall (590 mm per year). The diverse conditions of aspect and elevation under which Mesa Butte soil is found are likely to result in substantial departures from this general description. Mesa Butte soil mapped on steep south-facing hillsides undoubtedly receives more sunlight and heat than soils with other aspects. When found near the tops of ridges, it probably has a longer frost-free period than anticipated. This occurs because downslope drainage at night transports cold air into the valleys and reduces the likelihood of late spring or early fall frosts at higher elevations. The steep slopes, open vegetation and shallow soils promote low infiltration, low storage and rapid runoff of rainfall. Therefore, the soil climate is undoubtedly drier than would be expected from a consideration of the normal precipitation values.

A representative profile of Mesa Butte soil has a relatively thin (< 15 cm) black surface horizon, which overlies a dark brown to dark yellowish brown subsoil. The subsoil is composed principally of weakly weathered sandstone and shale fragments and contains numerous angular flags derived from the underlying bedrock. The transition to unaltered bedrock is gradual and takes place between 45 and 100 cm in most cases. Free lime sometimes accumulates at the bedrock contact but the overlying colluvial material is usually lime free. Horizon boundaries are often disrupted, and individual horizons are mixed as a result of downslope movement. All horizons are slightly acid to neutral in reaction. Mesa Butte is rapidly drained, moderately pervious and has a low moisture-retention capacity, largely due to its shallow depth to bedrock. Since it occurs almost exclusively on steep slopes, most surface drainage is very rapid and follows shallow troughs and gullies that lead directly downslope.

Mesa Butte is classified as an Orthic Black Chernozemic soil (lithic phase). Some very similar soils mapped along with Mesa Butte could be classified quite differently. In some instances the black surface horizon contains insufficient organic matter, lacks the proper structure, or has a mean annual soil temperature of less than 0°C, and, therefore, does not qualify as a Chernozemic Ah. These soils would be classified as Orthic Melanic Brunisols. Where the black surface horizon is less than 10 cm thick the soil may be an Orthic Eutric Brunisol. Where downslope movement has mixed and destroyed the original soil horizons, Cumulic and Cumulic Humic Regosols may be recognized (plate 29).

**Plate 29.** Mesa Butte soil

**MSB 1**

This unit is found on steeply sloping bedrock ridges in the foothills south and west of Calgary. The ridges are covered by a thin veneer of colluvium or colluviated till. The unit consists of various amounts of Mesa Butte and other soils, which share with Mesa Butte the common characteristics of shallow depth to bedrock and steep slope. These other soils form mostly on thin colluvium, but a few develop on colluviated till. Most have a black surface horizon, but some have only a leaf litter mat overlying brownish subsoil.

There is a high degree of variability in the classification of the soils contained within this unit. The properties, however, which most strongly affect interpretation of MSB 1 areas are quite uniform. Soils within this unit can be expected to vary in thickness, color and organic matter content of their surface horizons. Most will have at least some black topsoil, but some of the soils mapped on the north and east sides of ridges may have no surface topsoil. The depth to consolidated bedrock may also vary within MSB 1, but is generally less than 1 m. The texture of the subsoil will depend on the nature of the underlying bedrock and its degree of weathering. It, therefore, varies considerably.

The features that most strongly affect use of MSB 1 are depth to bedrock and slope. This unit always occurs on steep slopes which severely limit most uses. The shallow depth to bedrock further compounds the limitations caused by slope. MSB 1 areas are sometimes used for natural grazing. Cattle may gather in these areas at night to avoid the cold air which collects in low-lying areas. MSB 1 areas are otherwise unused and remain in their natural state.

## Midnapore (MDP)

Midnapore is a deep, rapidly drained, black grassland soil formed on glaciofluvial sediments in agroclimatic zone 1. The glaciofluvial parent material is sandy to coarse loamy, strongly calcareous, contains very few coarse fragments and exhibits weak stratification and cross-bedding indicative of deposition in a flowing water environment. Midnapore soil is found on nearly level to gently rolling glaciofluvial landscapes. It is mapped adjacent to the present Bow Valley and alongside several other former outwash channels. The sandy sediments often overlie till, but occasionally form deposits several meters thick. The surface sediments have likely been resorted by post-depositional wind erosion.

Almost all areas of Midnapore soil are cultivated. The original vegetation consisted of mixed prairie grassland in which fescue, porcupine grass, June grass, Hooker's oat grass and blue grama were the

dominant grasses. Midnapore is mapped along the western boundary of agroclimatic zone 1 and extends, in places, into agroclimatic zone 2H. Rainfall is adequate for most crops suited to the region and averages 400 mm per year. The frost-free period is greater than 90 days in most years.

A representative profile of Midnapore soil has a thick, black, loamy surface horizon (20 to 30 cm), which overlies a weakly structured dark yellowish brown oxidized horizon. A zone of lime accumulation occurs between 45 and 60 cm and changes gradually into light yellowish brown unaltered parent material. The parent material characteristically has a high sand content (55 to 65 percent sand) and a loose consistency when dry. Surface horizons have a high content of silt-sized material and may be partly aeolian in origin. All horizons are neutral to moderately alkaline in reaction. The soil is rapidly drained, rapidly pervious and has a low moisture-retention capacity. Rainfall enters the soil rapidly and is dispersed by subsurface flow. There are few large-scale surface drainage features associated with areas of Midnapore soil.

Midnapore is classified as an Orthic Black Chernozemic soil. Similar soils in some Midnapore areas have the same classification, but form on parent material with somewhat different textures or origins. Also included when mapping, are thin, less well-developed soils classified as Rego Black or Calcareous Black.

**MDP 1**

MDP 1 is mapped on smooth glaciofluvial landscapes adjacent to the Bow Valley south of Calgary. Most of the topography is nearly level to gently undulating. About 60 percent of the unit consists of Midnapore soil and about 30 percent is silty Rockyview soil. There are also small areas of thin, weakly developed, Happy Valley soil.

The soils contained in this unit are quite uniform in appearance. The surface horizon is consistently thick and black and almost all profiles have an oxidized subsurface horizon. The glaciofluvial sediments are almost always greater than 1 m deep and are usually several meters thick. The major variability arises from natural changes in soil texture and related properties within the glaciofluvial parent material. Substantial variation in sand or clay content may be anticipated wherever Midnapore soil is mapped.

Agricultural use of this unit is slightly limited by the low moisture-holding capacity of Midnapore soil. Water is not strongly retained and consequently the soil may become droughty during prolonged dry periods. Midnapore is otherwise a very desirable soil. The climate is favorable and there are no other prominent soil or landscape limitations. This soil might be expected to be susceptible to erosion, but no areas of substantial wind or water erosion were encountered. MDP 1 areas have few limitations for most non-farm uses. Performance of reservoirs or sanitary landfills may be adversely affected by high permeability. Soils of this unit are well suited to the construction of roads and structures and some the deeper deposits might be useful as sources of sand.

Only a few MDP 1 areas have been mapped. Several are cultivated and the principal crops are barley and hay. Others have been exploited or investigated as sources of sand and are no longer suitable for agricultural use. Encroaching urban development has led to use of some MDP 1 areas for residential subdivisions.

**MDP 2**

This unit is mapped on undulating, ridged and slightly hummocky glaciofluvial landscapes. The glaciofluvial parent material is usually 1.5 to 5 m thick and overlies till. Irregularities in the surface topography create closed depressions in which water and eroded material accumulate. Some ridges may be due to retransport of the sandy parent materials by wind. About 50 percent of this unit consists of sandy Midnapore soil and 20 percent is silty Rockyview soil. A further 20 percent is poorly drained DeWinton soil and most of the rest of the unit is weakly developed, sandy Happy Valley soil. There is some interfingering of gravelly soils at the boundaries between MDP 2 and BOV 1 areas.

MDP 2 areas are somewhat more variable than MDP 1 areas. The presence of significant scattered wet soils gives rise to a wider range in soil drainage than in MDP 1. The wet soils also tend to contain more silt and clay than Midnapore. Subsoil texture varies widely as in MDP 1.

The low moisture-holding capacity of Midnapore soil is the main limitation to agricultural use of MDP 2 areas. Further slight limitations sometimes result from adverse topography, the presence of numerous small areas of wet soil and the resulting pattern disruption that affects use of the unit as a whole. The wet soil component of this unit is poorly suited to most agricultural and non-farm uses. As with MDP 1, some non-farm uses may be adversely affected by the rapid permeability of the parent material. The rapid permeability and low plasticity of the Midnapore soils in this unit, however, make them suitable for structures and roads. Some MDP 2 areas may warrant investigation as possible sources of sand. Currently, the few areas of MDP 2 mapped are in fallow or idle and awaiting urban development. One area has been extensively disturbed by sand quarrying operations and is no longer suitable for cultivation.

**MDAD 1**

This unit is mapped on smooth glaciofluvial landscapes adjacent to the Bow Valley south of Calgary. The glaciofluvial parent material occurs as a thin veneer overlying till and is often less than 1 m thick. The topography is mainly nearly level to gently undulating and reflects irregularities in the underlying till surface. About 50 percent of the unit consists of sandy Midnapore soil. About 20 percent is Academy soil which forms on till and a similar amount is silty Rockyview soil. The remainder of the unit consists of sandy, weakly developed Happy Valley soil or soils that have till within 1 m of the surface.

MDAD 1 areas have a uniform appearance at the surface. The black topsoil is continuous and thick (20 to 30 cm) and most soils have an oxidized subsurface horizon. The major variability arises from changes in

subsurface properties and composition. The parent material encountered within the top meter may be either glaciofluvial or till. Consequently, such subsoil properties as texture, permeability and plasticity are frequently highly variable.

There are only minor constraints to agricultural use of MDAD 1 areas. The low moisture-retention capacity of the coarse loamy glaciofluvial veneer is partially offset by the presence of till within 1.5 m of the surface. The till surface creates a barrier to downward water movement and can promote accumulation and storage of soil moisture within the rooting depth of most crops. There are no other soil or landscape limitations that substantially affect crop growth in MDAD 1 areas. Some non-farm uses may be restricted by the rapid permeability of the coarse loamy glaciofluvial material, but again, the presence of less permeable till within 1.5 m of the surface may offset this limitation. MDAD 1 areas otherwise have only minor limitations for most engineering uses.

**MD-L 1**

This unit is found on nearly level to gently undulating terraces cut into bedrock along major meltwater channels. Most of the unit consists of a lithic phase of Midnapore soil in which hard sandstone bedrock occurs within 1 m of the surface (80 percent). Included when mapping are some soils that contain no bedrock above 100 cm. Also included are a few stony and rocky soils and occasional wet soils in depressions and near springs.

In this unit, the sandy parent material is usually less than 1 m thick and lies directly on hard bedrock. The topography is nearly level and there are few wet soils.

The MD-L 1 unit is generally too droughty and too shallow for sustained crop growth. Although the climate is suitable for cultivation of most local crops, the areas are usually kept in pasture. Some non-farm uses are limited by rapid permeability and shallow depth to bedrock.

## Nose Creek (NSK)

Nose Creek is a thin, weakly developed, moderately well to well-drained, black grassland soil formed on scoured till in agroclimatic zones 1 and 2H. The till is fine loamy in texture, extremely calcareous, moderately saline, contains 5 to 15 percent coarse fragments and is predominantly Continental in origin, but appears to have been reworked by flowing water.

Nose Creek soil is mapped along the bottoms of two glacial scour channels north of Calgary. The topography ranges from nearly level to dissected and hummocky. The till parent material averages 1.5 to 2 m in depth and overlies flat-lying Paskapoo sandstone. Gullies and stream channels cut through and expose bedrock in numerous places.

Nose Creek areas support a mixed grassland vegetation regime. The most common grasses are wheatgrasses, blue grasses and blue grama. The climate includes adequate rainfall (400 mm per year) and a moderately long frost-free season (80 to 100 days). The soil is placed in agroclimatic zone 2H for purposes of agricultural consideration, since the low landscape position in which it is found is believed to be more susceptible to unseasonable frosts than are surrounding upland areas.

A representative profile of Nose Creek soil has a thin black surface horizon, which usually lies directly on light olive brown to light yellowish brown parent material. There is sometimes a thin (<5 cm) dark brown oxidized horizon between the surface and subsurface horizons. White alkali salts often accumulate in the subsoil at depths of from 40 to 90 cm. The surface horizon is usually mildly alkaline and the subsoil is moderately to strongly alkaline. Nose Creek soil is well drained, moderately pervious and has a medium moisture-retention capacity. A centrally located stream dominates the surface drainage in areas of Nose Creek soil, but secondary channels, meander scars and lateral gullies also dissect the landscape.

Nose Creek is classified as a Rego Black Chernozemic soil. Some similar soils mapped in association with Nose Creek are classified as Orthic Black and Solonetzic Black.

**NSK 1**

This unit is found on well to imperfectly drained, undissected, upper terraces adjacent to glacial scour channels, such as those occupied by Beddington and Nose Creeks. The surface topography is usually smooth and slopes are nearly level to gently undulating. Bedrock underlies all soils in this unit but usually occurs below 1 m depth. About 40 percent of this unit consists of Nose Creek soil and 30 percent is a similar, more strongly developed soil. The remainder of the unit consists of variable amounts of alluvial Tweedsmuir soil and some soils in which bedrock occurs near the surface.

This is the least variable of the Nose Creek soil units. It is uniformly well-drained, contains the fewest lithic soils and has the most regular topography. Some changes in parent material texture are associated with minor inclusions of recent stream sediment in the unit. A few areas are exceedingly stony.

Agricultural use of NSK 1 areas is limited slightly by the length of the frost-free season (80 to 100 days). A collection of minor adverse features such as thin topsoil, stoniness, rapid surface runoff and drainage, subsoil salinity and susceptibility to occasional flooding combine to make NSK 1 areas slightly less favorable for cultivation than adjoining soils located outside the outlined limits of the channels. An additional limitation arises from the small size of NSK 1 areas and from the roughness of the areas that separate adjacent NSK 1 occurrences. Engineering uses are affected by the flooding hazard, the presence of bedrock within a few meters of the surface and by the presence of corrosive sulfate salts in the subsoil. NSK 1 areas are primarily used for pasture. A few areas are cultivated and the main crop is barley.

**NSK 2**

This unit is mapped on well to poorly drained, lower terrace and stream channel portions of Beddington and Nose Creek Valleys. The surface topography is

quite rough due to dissection of the landscape by active and abandoned stream channels. Bedrock is exposed along the sides of most channels and underlies most soils. About 30 percent of the unit is Nose Creek soil and 20 percent consists of similar, more strongly developed soils. Alluvial Tweedsmuir soil occupies about 20 percent of the unit, as does poorly drained Balzac soil. The remainder of the unit consists of soils that have bedrock within 1 m of the surface and sometimes form entirely within bedrock material.

There is great variability in soil and landscape properties within this unit. Texture varies according to whether the parent material is till, recent fluvial or weathered bedrock. Soil moisture status changes considerably with wet soils occurring adjacent to stream channels and in shallow depressions. The depth to bedrock is not consistent but is frequently less than 1 m. Some soils have very thin topsoil horizons and others have recurring horizons of erosion and deposition, which indicate repeated flooding of the unit. Subsurface hardpan horizons form in a few spots which are subject to saline discharge or which have saline bedrock very close to the surface.

There are numerous severe limitations to almost all potential uses of NSK 2 areas. Cultivation is not feasible due to the rough, dissected topography and numerous stream channels. Further agricultural limitations are caused by shallow depth to bedrock, numerous areas of wet soil, high susceptibility to flooding, thin topsoil horizons and adverse surface stoniness. Many of these features also restrict non-farm uses of NSK 2 areas. In addition, there exists a potential for contamination of surface and subsurface water and for corrosion of concrete and steel by soluble sulfate salts in the subsoil. NSK 2 areas are normally used for watering and pasturing livestock. They are unsuited for most other uses.

### NSK 3

This unit forms on undissected upper terraces within meltwater channels that contain scattered shallow depressions, infilled with recent lacustrine clay. The surface topography is usually smooth and slopes are nearly level to gently undulating. Bedrock usually occurs between 1 and 3 m from the surface throughout this unit. About 50 percent of the unit is Nose Creek soil. Thin, imperfectly drained, black, hardpan type soils formed on both till and recent lacustrine clay comprise about 30 percent of the unit, and about 20 percent is poorly drained, saline Balzac soil.

Different types of parent material may be encountered within NSK 3 areas. Consequently, differences in texture and related properties may be large. Changes in soil moisture status are also common, with wet soils usually found on the clayey parent materials. Subsurface hardpan horizons may be encountered, particularly surrounding the wet, clay-filled depressions.

Agricultural use of NSK 3 areas is limited only slightly by the moderately long frost-free period (80 to 100 days). Greater limitations are due to thin topsoil, subsoil salinity, stoniness and susceptibility to occasional flooding. Parts of NSK 3 areas are limited by soil wetness, adverse structure or low permeability. Engineering uses are affected by the flooding hazard, by the presence of bedrock within a few meters of the surface, by the concrete and steel corrosion hazard arising from high soluble salt concentrations in the subsoil and by scattered areas of high soil wetness. NSK 3 areas are not cultivated. They are used mainly for pasture and for watering livestock.

## Pothole Creek (POT)

Pothole Creek is a wet, clayey soil with a black surface horizon. It forms on fine clayey, stone-free, strongly calcareous, glaciolacustrine parent material in agroclimatic zones 3H and 5H. It is found most frequently as inclusions in areas of better-drained soils, such as Fish Creek. Occurrences large enough to be mapped separately usually develop in low-lying portions of the glaciolacustrine landscape, adjacent to stream channels or within large depressions. Pothole Creek soil is mapped in the glaciolacustrine basins and valleys west and southwest of Calgary.

Areas of Pothole Creek soil support a moisture-adapted vegetation community dominated by grasses, sedges, various species of willow, water birch (*Betual occidentalis*) and the occasional aspen or balsam poplar. This soil has a unique, cold, moist microclimate due to its low-lying landscape position and permanently high soil moisture status. It is, therefore, highly susceptible to unseasonal frosts and has a frost-free period of much less than 60 days. For this reason, it can be interpreted as being an agroclimatic zone 5H soil wherever it occurs.

A representative profile of Pothole Creek soil has a thick black mineral surface horizon, which is sometimes overlain by an accumulation of moderately decomposed organic material. These layers overlie a dark-colored, weakly structured, lime-free horizon, which contains mottles indicative of periodic saturation and drying. The unaltered parent material is encountered between 60 and 80 cm and is usually dark grayish brown to olive brown. It contains few mottles, but the dull colors indicate more or less permanent wetness. The surface horizons are slightly acidic in reaction, and the subsoil is mildly alkaline. All horizons contain large amounts of clay and are usually moist or wet. There is an increase in clay content with depth, from about 40 to 50 percent clay in the topsoil to 70 to 80 percent in the subsoil. This soil is very poorly drained, slowly pervious and has a high moisture-retention capacity. There are few surface drainage features associated with Pothole Creek soil as it usually occurs in undrained depressions.

Pothole Creek soil is classified as Orthic Humic Gleysol. A peaty phase of this soil is sometimes observed.

### POT 1

This unit occurs in low-lying portions of glaciolacustrine basins and valleys. The land surface is level to depressional and contains few irregularities. Almost all of the unit is Pothole Creek soil (80 percent). Included when mapping are some soils with peaty surface

layers and a few slightly better-drained soils. Almost all of the soils in this unit are wet, have high clay contents and are highly plastic in nature.

The short frost-free season and high soil wetness severely limit cultivation of POT 1 units. Most areas are in permanent pasture or are uncleared. Non-farm uses are severely restricted by the high clay content, high plasticity, low permeability, high water table and susceptibility to flooding.

**POT 2**

This unit occurs in low-lying portions of glaciolacustrine basins and valleys. The land surface has minor knolls and depressions. About 60 percent of the unit is Pothole Creek soil. The remaining 40 percent consists of Fish Creek and similar, better-drained soils that occur on slightly elevated knolls. The soils in this unit have a uniformly high clay content and high plasticity. They vary mainly in wetness and depth to water table.

This unit is generally too wet and cold for crops. Most areas are in permanent pasture. Cultivation of the better-drained soils in this unit is limited by their scattered distribution within areas of predominantly wet soil. Wetness, slow permeability, high water table, high clay content and susceptibility to flooding are limitations to most non-farm uses.

**POT 3**

This unit occurs along minor natural drainageways in glaciolacustrine basins and valleys. Much of the unit consists of Pothole Creek soil as described (40 percent). Included when mapping are small areas of better-drained Fish Creek soil on knolls (20 percent) and some Sarcee soil that forms in recent stream channel sediments (20 percent).

Most of the unit consists of soils that are wet, plastic and high in clay. The Sarcee soil is highly variable and contains more sand and silt than Pothole Creek soil. It is better drained, but still highly plastic.

A short frost-free season, soil wetness and the presence of stream channels and banks severely limit use of this unit for cultivated crops. Most areas are in permanent pasture. Wetness, slow permeability, high clay content, susceptibility to flooding and high water table limit most non-farm uses.

## Rockyview (RKV)

Rockyview is a deep, well-drained black grassland soil formed on thin loess overlying till in agroclimatic zone 1. The parent material is a fine silty, strongly calcareous, aeolian veneer overlying Continental till. It contains features that indicate resorting near the surface (plate 30). These include weak stratification, a low coarse fragment content and a stone line that occurs between 50 and 100 cm depth. This soil occurs on undulating to gently rolling landscapes. The underlying till is generally from 2 to 10 m thick. It is thinnest over bedrock-controlled highs and thicker in lower, more level areas. A few steep slopes border glacial meltwater channels.

The natural vegetation is mixed prairie grassland. The main grasses are fescue, porcupine grass, spear grass, blue grama grass, June grass and blue grasses. Presently, most areas are cultivated or seeded to improved pasture. Rockyview is mapped primarily within agroclimatic zone 1. Precipitation averages 400 mm per year and the frost-free period is usually greater than 90 days.

Rockyview has a relatively thin, black, loamy surface horizon (13 to 16 cm) underlain by a brown, oxidized horizon and a whitish gray to buff subsoil. The till subsoil characteristically has a high content of carbonate and silt-sized material. The soil is well drained, moderately pervious and has adequate moisture retention. Most rainfall enters the soil through infiltration, but some surface runoff may occur on steep slopes or during heavy rains.

Rockyview is classified as an Orthic Black Chernozemic soil. Similar associated soils are classified as Rego Black and Solonetzic Black. It is always mapped in association with Academy soil, which lacks an aeolian veneer.

**RKAD 1**

This unit consists mostly of Rockyview and Academy soils. It may contain minor amounts (< 15 percent) of Gleysolic or other contrasting soils, but they are not of sufficient extent to affect any interpretations. RKAD 1

**Plate 30.** Rockyview soil

areas occur on smooth, undulating to gently rolling morainal topography. They form in a zone that parallels the western limit of the last Continental glacial advance in the study area.

Soil properties are relatively uniform throughout this soil unit. Some variability occurs with respect to the thickness of the black surface horizon and to total profile depth. Surface horizons and profile depths are usually thinnest near the tops of ridges and knolls and thickest in depressions and on toe slopes. The silty surface veneer is variable in thickness and extent. Generally, this unit presents few constraints for most uses. Agriculturally, it has a favorable climate, though a slight frost hazard is recognized.

Presently, RKAD 1 units are being used extensively for agriculture. Major crops include barley, canola, oats, rye, wheat, alfalfa, clover and hay. The relatively small amount of land sown to wheat suggests that many farmers feel the danger of frost damage to this crop is significant.

**RKAD 2**

RKAD 2 units are mapped on lower portions of the morainal landscape where the water table frequently approaches the surface, and in areas of slightly hummocky topography where the lack of an integrated drainage network results in a pock-marked pattern of poorly drained depressions. This unit consists mostly of Rockyview and Academy soils (70 percent), but also includes considerable percentages of Gleysolic soils (15 to 30 percent), which occupy wet, depressional areas.

The hummocky nature of the landscape frequently associated with this unit often gives rise to greater variability in the thickness of the surface horizon (Ah) and total profile depth than found in RKAD 1. The extensive presence of Gleysolic soils also increases the variability of the drainage conditions encountered in soils of this unit. The wet soils are generally saline and fine textured (see BZC). They are usually avoided during cultivation and likewise are poorly suited to many other land uses. In most cases, however, the disruption to land use caused by these wet soils is not great enough to limit the usefulness of the remaining soils in the unit. The well-drained soils may be interpreted as belonging to the RKAD 1 unit. RKAD 2 unit is generally used for the same crops as RKAD 1. Generally, however, a higher proportion of this unit is seeded to pasture or forage crops.

**RKAD 3**

This unit is mapped on moderate to steep till-covered hillsides. The till forms a mantle from one to several meters thick over sandstone bedrock. It, in turn, is covered by a patchy distribution of thin silty loess. The main soils are Rockyview and Academy (70 percent), but many profiles are thinner, drier or less strongly developed than these main soils.

The major variability within RKAD 3 arises from the erosion of topsoil from the upper slopes of the unit and its redistribution in hollows and along toe slopes. Soil profiles are thin on the steep portions of the unit and have thicker surface horizons (Ah) where eroded material has accumulated. The availability of water varies widely in this unit. Soils within drainage paths have more available moisture than in the remainder of the unit. Depth to bedrock is also variable, but may be assumed to be greater than 1 m over the whole unit unless the lithic phase symbol (/1) is used. Steepness of slope forms the main limitation to most uses of this unit. For agriculture, low available soil moisture and soil erosion may be additional constraints. For some engineering uses, depth to bedrock may become limiting particularly where the lithic phase is recognized. Many of the more-gentle slopes within this unit are cultivated to the same crops as in RKAD 1. On steeper slopes, the land is generally left in pasture or used for hay production.

**RKAD 4**

This unit occurs on smooth, undulating to gently rolling landscapes similar to those of RKAD 1. Solonetzic soils occur in patches throughout the landscape, but appear to form preferentially in places where the water table is close to the surface. Such places include low spots and positions along bedrock-controlled slopes where groundwater discharge occurs. This unit consists of Rockyview (40 percent), Academy (30 percent) and a sizable amount of Solonetzic soils (Beddington 15 to 30 percent) that cannot be mapped separately at this scale.

The major variability within this unit is related to soil type. Where Solonetzic soils occur, soil permeability is low and wet spots may develop after periods of rainfall or snowmelt. During dry periods, a hardpan (Bnt) may form at about 13 to 18 cm, restricting root penetration and impeding cultivation. This unit is similar to RKAD 1 and has few limitations for most uses. The scattered spots of Solonetzic soil present moderate limitations to agriculture and to some engineering uses. The high sulfate content of the Solonetzic soils may present a concrete corrosion hazard. Land use in RKAD 4 units is primarily agricultural and generally similar to that in RKAD 1. RKAD 4 areas are uniformly seeded, but reduced yields may be expected from the Solonetzic soil areas particularly in abnormally wet or dry years.

**RKAD 5**

This unit occurs on slightly rough, undulating, ridged or hummocky morainal landscapes that are covered by a thin veneer of silty loess. The irregular topography results in more thin, weakly developed and eroded profiles than found on smoother landscapes. About 30 percent of the unit consists of silty Rockyview soil and 20 percent is Academy soil. The remainder of the unit consists mainly of the less well developed Eastbow and Sharp Hill soils along with scattered patches of eroded or poorly drained soils.

The thickness and degree of development of soil profiles vary widely in this unit. Weakly developed profiles are common. Soil drainage is often more variable than in RKAD 1 and imperfectly drained soils often comprise large portions of the unit. This unit is affected by a slight agricultural limitation resulting from soil erosion. This reduces its capability rating by 1 class relative to similar, non-eroded RKAD 1 areas. Most

non-farm uses are not limited by the properties of this unit, although the high silt content of some soils may result in a moderate frost heave hazard.

Presently most RKAD 5 areas are used for production of barley, canola, oats, rye, wheat, alfalfa, clover or hay. Uneven growth of some crops has been noted on the eroded areas.

## Rough Broken (RB)

This is an undifferentiated land unit confined to steep valley sides with slopes greater than 20 percent. Numerous combinations of soils are present in these areas, but all are interpreted similarly. Steepness of slope is more important than soil properties or climate in determining most limitations for use of Rough Broken areas. Climate and vegetation vary greatly and are strongly controlled by aspect. Several soil units are defined to allow for recognition of different types of parent material and differing amounts of included bedrock. Four units are used in this survey.

**RB 1**

This unit occurs on steep till covered slopes (plate 31). Bedrock probably controls the slope at depth, but is seldom encountered in shallow excavations. The slopes appear to be stable in their present state. Most of the unit consists of thin, dark-colored grassland soils similar to those described for ATL 3 and DVG 3 soil units. Included when mapping are many soils with little or no black topsoil, some light-colored forested soils, some slopewash soils and isolated spots of hard bedrock outcrop.

This unit is too steep for cultivation. Most areas are in permanent pasture or remain in aspen forest. Slope is a limitation to most non-farm uses.

**RB 2**

This unit occurs on steep slopes that have only a thin veneer of colluvial material overlying bedrock. Included in this unit is a wide variety of light- and dark-colored soils. They commonly contain buried topsoil horizons and oriented pebbles indicative of instability and periodic downslope creep. These soils often have bedrock within 1 m of the surface. Also included are some isolated occurrences of consolidated bedrock.

This unit is too steep for cultivation. It is sometimes used for pasture, but may be too rocky or steep for agricultural use. Steep slopes, instability and shallow depth to bedrock limit many non-farm uses.

**Plate 31.** RB 1 topography

**RB 4**

This unit is mapped on steeply sloping, v-shaped, intermittent drainage ways and gullies. The bounding sides of the unit are mostly till and seldom have bedrock within 1 m of the surface. The central drainage channel is often imperfectly to poorly drained and contains scattered deposits of fine loamy alluvium. Most of the unit consists of thin, dark-colored grassland soils similar to those described for ATL 3 and DVG 3 mapping units. Included within the central drainage channels are alluvial soils similar to Tweedsmuir and Sarcee.

This unit is too steep and irregular for cultivation, most areas being used for pasture. Slope and flooding hazard limit most non-farm uses.

**RB 5**

This unit occurs on steep slopes formed on fine silty to fine clayey glaciolacustrine sediments. The slopes separate different levels of glaciolacustrine terraces and seldom have any bedrock control or exposure. Included in this unit are some black, grassland soils that resemble Lloyd Lake and other soils with weak profile development and little or no topsoil. Also included are some steep, unvegetated exposures of sandy to silty unaltered glaciolacustrine sediments.

This unit is too steep for cultivation and is often too sensitive for pasture. It is seldom used for agricultural purposes, because disturbing the slopes may induce severe erosion or instability. Non-farm uses are severely limited by steep slopes, erosion hazard and potential instability.

## Sarcee (SRC)

Sarcee is a deep, well to rapidly drained, dark-colored transitional soil. It forms on highly variable recent alluvial deposits in agroclimatic zones 3H and 5H. The alluvium is strongly calcareous, generally contains less than 5 percent coarse fragments, and is fine to coarse loamy in texture. Sarcee soil is mapped on level to gently inclined terraces and strongly dissected valley floors of streams and rivers west of Calgary.

The natural vegetation consists of a mixture of grassland and forest. Grasses such as rough fescue, wheatgrasses and blue grasses predominate, but most areas are partially treed or have been treed in the past. Willow, aspen, balsam poplar and some white spruce are the most common trees. Sarcee soil is usually associated with a cool, moist climate. Precipitation averages 590 mm per year and the frost-free period is less than 60 days.

A representative profile of Sarcee soil has a relatively thick, black to dark gray, loamy surface horizon. Below this is a thin, weakly structured, weakly oxidized subsurface horizon. Below about 30 to 40 cm, the subsoil consists of unaltered calcareous parent material.

The parent material is weakly bedded and has a wide variation in texture and related properties. The surface horizon is neutral to mildly alkaline in reaction and the subsoil is moderately alkaline.

Sarcee soil is rapidly drained and moderately to rapidly pervious. It has a medium moisture-retention capacity. Surface drainage is dominated by a central stream channel, but numerous abandoned channels and transverse gullies may exist.

Sarcee is classified as an Orthic Black Chernozemic soil. Included with this soil when mapping are some soils with lighter-colored surface horizons (Orthic Dark Gray) and many soils that lack subsurface oxidized horizons (Rego Black and Rego Dark Gray). Also included are soils that have several buried topsoil layers indicative of periodic flooding. They are classified as Cumulic Regosols if the topsoil is less than 10 cm thick and as 'Cumulic' Rego Black Chernozemics where the topsoil thickness exceeds 10 cm.

**SRC 1**

This unit is found on well-drained upper terraces along streams, rivers and minor natural drainage ways west of Calgary. Most of the unit consists of Sarcee (50 percent) or similar soils with weak profile development (30 percent) or dark gray topsoil horizons (20 percent). There are only occasional occurrences of wet soil.

In this unit, the soils are almost all well drained. The alluvial parent material is consistently more than 1 m thick, but it has a wide natural range in texture and related properties. The land surface is nearly level to gently inclined and is not strongly dissected.

Agricultural use of this unit is limited by the short frost-free season. SRC 1 areas are generally small and cultivation is often restricted by rough topography and wetness in surrounding areas. Most areas are used for pasture, but a few are cultivated. Coarse grains and forage crops are grown on the cultivated land. Non-farm uses may be limited by a seasonal flooding hazard or high water table, high potential for groundwater contamination, high plasticity and high frost heave potential.

**SRC 2**

This unit is found on well to poorly drained, strongly dissected lower terraces and stream channels west of Calgary. About 40 percent of the unit is Sarcee soil. About 30 percent consists of well-drained soils that are weakly developed or cumulic and show evidence of repeated flooding activity. The remaining 30 percent of the unit is poorly drained soil, which occurs in depressions, along active stream channels and in abandoned drainage ways.

This unit is more variable than SRC 1. A wide variety of drainage conditions can occur, but individual areas are too small to separate at this scale of mapping. The alluvial parent material is also more variable than in SRC 1. In addition, there are many wetter and frequently flooded soils in this unit than in SRC 1. Finally, the land surface is much rougher than in SRC 1, mainly due to dissection by active and abandoned stream channels.

This unit is seldom cultivated. The short frost-free season severely limits the choice of crops. Strongly dissected topography, numerous channels, wet soils and high seasonal flooding hazard further limit normal cultivation. Most areas are in pasture and are used for grazing and livestock watering. Non-farm uses are adversely affected by a seasonally high water table and flooding hazard, dissected topography, high potential for contamination of surface and groundwater, high plasticity and high frost heave potential.

**SRC 3**

This unit is found on well to rapidly drained upper terraces adjacent to stream channels west of Calgary. About 50 percent of the unit consists of Sarcee and similar soils that are less strongly developed. About 30 percent consists of well-drained alluvial soils that have gravel at 50 to 100 cm depth. The remainder of the unit is mainly gravelly Sundre soil.

In this unit, the alluvial sediments are often less than 1 m thick and overlie well-sorted, well-rounded, glaciofluvial outwash gravel. The gravel promotes rapid permeability and drainage, so wet soils occur only where the water table is close to the surface. Most SRC 3 areas are nearly level to gently inclined and are not strongly dissected.

This unit is seldom used for growing crops. The short frost-free period severely limits the choice of suitable crops, and the underlying gravel causes problems with droughtiness. Most areas are cleared for pasture or remain wooded. Grazing and livestock watering are the most common farm uses. This unit is a potential source of gravel, but shallow depth to water table may hinder recovery operations. Non-farm uses are limited by seasonally high water table and flooding hazard, high potential for contamination of surface and groundwater, and rapid permeability.

**SRC 4**

This unit is found on well to poorly drained lower terraces and stream channels west of Calgary. About 40 percent of the unit consists of Sarcee and similar well to imperfectly drained alluvial soils. Similar soils which have gravel within 1 m of the surface make up about 20 percent of the unit; about 10 percent is gravelly Sundre soil. The remainder of the unit consists of poorly drained soils or recently deposited gravel. They occur in depressions along active stream channels and in abandoned drainageways.

In this unit, the alluvial sediments are often less than 1 m thick and overlie well-sorted, well-rounded, glaciofluvial outwash gravel. The gravel promotes rapid permeability and drainage; consequently, wet soils occur only where the water table is close to the surface. Most SRC 4 areas are strongly dissected by active and abandoned drainage channels.

As in SRC 3 soils, the short frost-free period and the dryness that results from the underlying gravel are reasons why there is little agricultural use of this unit. Many areas remain wooded and are used for woodland grazing. A few have been cleared for use as improved pasture. Non-farm uses, including potential recovery of gravel, are limited as for SRC 3.

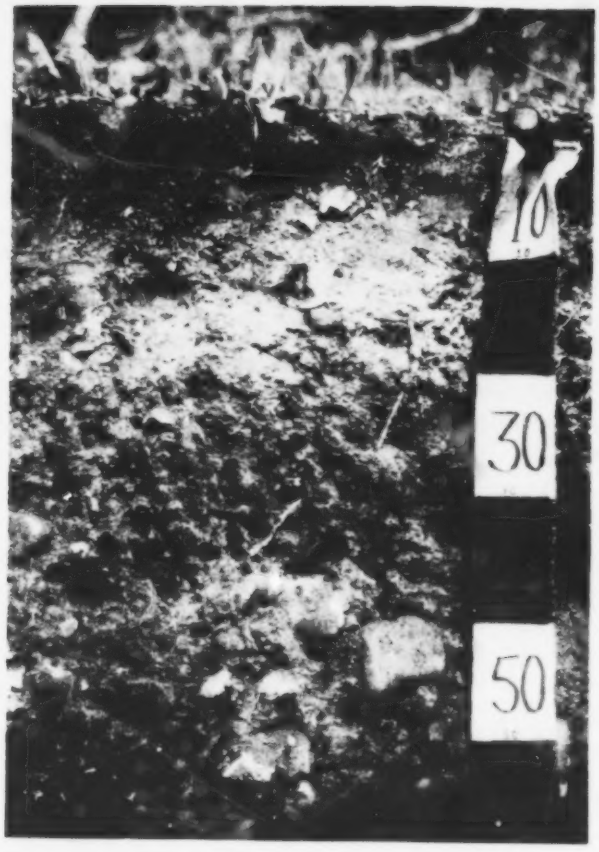



**Plate 32.** Profile of an Orthic Gray Luvisol of the Spruce Ridge soil group

## Spruce Ridge (SPR)

Spruce Ridge is a moderately deep, well-drained, light-colored forested soil. It forms on weakly calcareous, fine loamy, Cordilleran till, which often contains up to 40 percent coarse fragments. The till forms a veneer 1 or 2 m thick overlying ridged sandstone and shale bedrock in the foothills southwest of Calgary.

Spruce Ridge soil is found under a Boreal Forest vegetation. The main trees are white spruce, aspen, balsam poplar, willow, alder and scattered lodgepole pine. The understory is quite thick and consists of typical boreal forest shrubs and forbs. The climate is cool and moist. Precipitation averages 590 mm per year and the frost-free period is less than 60 days; this combination places the soil in agroclimatic zone 5H.

A representative profile of Spruce Ridge soil (plate 32) has a thin, black surface mat of relatively poorly decomposed leaf litter. Below this, there is sometimes a dark gray, humus-rich horizon, no more than 5 cm thick. This overlies a light-colored, platy horizon, which is leached of organic matter and clay. The next horizon is dark brown to dark yellowish brown, has a moderately strong subangular blocky structure, and is enriched in clay leached from above. The parent material is from 60 to 90 cm deep. It is dark to pale brown, has some free lime and contains from 15 to 30 percent coarse fragments—mostly rounded calcite and dolomite cobbles. The surface mineral horizons are strongly to medium acidic in reaction, and the parent material is neutral to mildly alkaline.

Spruce Ridge soil is well drained, moderately pervious and has a medium moisture-retention capacity. Because it occurs most often on steep slopes, surface drainage is rapid and follows shallow troughs and gullies.

Spruce Ridge is classified as an Orthic Gray Luvisol. Included when mapping are some similar soils that do not have a strongly developed zone of clay accumulation. They are classified as Eluviated Eutric Brunisols. They form where steady downslope creep disrupts normal profile development or where rapid surface runoff limits infiltration and leaching. Concentration of eroded topsoil in draws, gullies and toe slopes gives rise to some soils with thick, black surface horizons that may be classified as 'Cumulic' Black Chernozemic or Cumulic Humic Regosol.

**SPR 1**

This unit is mapped on strongly sloping, till-mantled bedrock ridges. Almost all of the unit is Spruce Ridge (50 percent) or similar soils (20 percent). Included when mapping are a few soils with dark surface horizons more than 5 cm thick, some soils with bedrock at 50 to 100 cm and a few spots of wet soil associated with springs and gullies.

In this unit, a gravelly clay loam till mantles strongly sloping, ridged bedrock. The till is generally 1 to 2 m thick but is deeper in valleys and at the base of slopes. Bedrock outcrops and shallow lithic soils are found mainly in upper slope positions on very strong slopes. The till normally has a high coarse fragment content consisting of from 15 to 30 percent rounded calcite and dolomite cobbles. Soils with more than 5 cm of black topsoil form in some open patches under grass, or in draws and toe slopes where slopewash has accumulated.

SPR 1 is unsuitable for cultivation. The major limitations are the short frost-free season and steep slopes. Most areas are forested and are unused or used for woodland grazing. Non-farm uses are limited by steep slopes, shallow depth to bedrock and lack of topsoil.

**SPR 2**

This unit is mapped on strongly sloping, till-mantled, south-facing bedrock ridges. About 40 percent of the unit is Spruce Ridge soil. About 30 percent consists of soils that have more than 5 cm of black topsoil. The remainder of the unit consists of wet soils that form in depressions, gullies and seepage spots, or lithic soils, which have bedrock within 1 m of the surface.

This unit occurs most often on south- and west-facing hillsides, which are warmer and have more grass-covered open areas than nearby SPR 1 areas. Other than having a thicker cover of black topsoil, SPR 2 areas are very similar to SPR 1 areas.

SPR 2 is not suitable for cultivation, due to a short frost-free season and steep slopes. Most areas are forested. They are used for woodland grazing or are unused. Non-farm uses are limited by steep slopes

and sometimes by shallow depth to bedrock.

## Spy Hill (SPY)

Spy Hill is a thin, well-drained, black grassland soil. It forms on strongly calcareous, fine loamy till. The till is predominantly Cordilleran in origin and is very stony (plate 33). Coarse fragments make up 20 to 30 percent of the parent material and are mainly rounded calcite and dolomite cobbles. Spy Hill occurs on hummocky topography. Slopes are short, steep and irregular. Rapid surface runoff of precipitation results in low infiltration and high erosion on these slopes. Consequently, the soils found in this topography have shallow profile development and a thin, black topsoil horizon.

Spy Hill soil occurs on till, but is often associated with buried gravel deposits. Preglacial outwash gravel underlies many areas where Spy Hill soil is mapped. The gravel occurs at depths of 10 m or more, but its presence contributes to the stoniness of the till parent material. A few areas of Spy Hill soil are associated with less deeply buried, ice-contact gravel deposits. In these areas, about 2 to 3 m of stony till overlies strongly sloping glaciofluvial kame and esker deposits. Spy Hill soil is mapped on the Spy Hill upland north of Calgary and in parts of the Priddis Valley southwest of Calgary.

This soil is found under mixed forest and grassland vegetation. Some areas are mainly aspen with willow, balsam poplar and occasional white spruce. Other areas are dominantly grasses such as rough fescue, spear grass, wheatgrasses, June grass, Hooker's oatgrass and Parry's oatgrass (*Danthonia parryi* Scribn.), with only scattered willow and aspen. The climate varies depending on aspect and landscape position, but is generally cool and moist. The frost-free period averages 60 to 75 days and annual precipitation is about 470 mm per year. Spy Hill is considered to be an agroclimatic zone 3H soil.

A representative profile of Spy Hill soil has a thin (10 to 12 cm), loamy, black surface horizon. Below this is a thin, weakly structured, dark brown to dark yellowish brown oxidized horizon. The parent material begins between 15 and 40 cm deep. It is dark grayish brown to light brownish gray in color, very stony and contains 20 to 30 percent calcium carbonate. The surface horizon is medium acidic to neutral, and the subsoil below about 30 cm is mildly alkaline.

Spy Hill soil is well drained and moderately pervious. It has a medium moisture-retention capacity for water that infiltrates the soil. Surface drainage is rapid as a result of the short, steep slopes. The hummocky topography causes a deranged pattern of surface drainage consisting of numerous undrained depressions and few natural drainage ways.

Spy Hill is classified as an Orthic Black Chernozemic soil, thin phase. Included with this soil when mapping, are many soils which have a very thin or absent subsurface oxidized horizon (Bm). These are classified as Rego Black soils and are commonly found near the crests of hummocks. Also included, are some soils with dark gray rather than black topsoil. These Dark Gray Chernozemic soils are associated with denser tree cover and more soil leaching. Orthic Humic Gleysols are found in depressions common to Spy Hill soil areas.

### SPY 1

This unit is found on hummocky and ridged till landscapes. Most of the unit (50 percent) is Spy Hill soil as described. Included when mapping are many soils with thin profile development and no subsurface oxidized horizons (30 percent), and a few soils with dark gray rather than black topsoil (10 percent). Less than 15 percent of the unit consists of wet soils.

In this unit, the till parent material is generally 10 or more meters thick. Preglacial gravel is often found beneath the till, but it is not economical to extract, due to the thickness of overburden. In a few places, gravel is suspected within 1 to 3 m of the surface, where steep-sided, ice-contact kames and eskers are draped with a relatively thin mantle of stony till. These areas are indicated on the soil map (/gv).

Agricultural use of SPY 1 areas is limited by the relatively short frost-free season, by steep slopes, irregular topography, stoniness, rapid surface runoff and erosion. About 10 percent of the soils in SPY 1 units are limited by wetness. Most SPY 1 units remain under aspen forest or are used for improved pasture. A

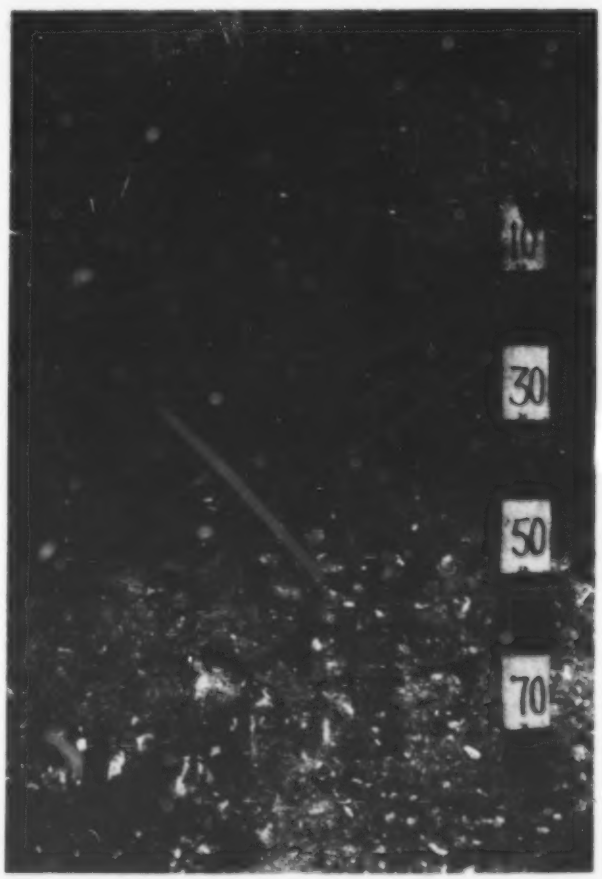



**Plate 33.** Spy Hill soil

few areas are cultivated and produce coarse grains. This unit is also popular for country residential development. Non-farm uses are limited by steep slopes, irregular topography, moderate permeability and stoniness.

**SPY 2**

This unit is found on hummocky till landscapes. About 40 percent of the unit is Spy Hill soil. About 30 percent consists of dark gray, rather than black topsoil. About 30 percent of the soils in this unit are poorly drained. This unit is similar to SPY 1 and differs mainly in having more depressions and wet soils.

Agricultural use of SPY 2 areas is limited by the relatively short frost-free season and by steep slopes, irregular topography, stoniness, rapid surface runoff and erosion. About 30 percent of the soils in SPY 2 units are limited by soil wetness. Most SPY 2 areas remain under aspen forest or are used for improved pasture. These areas are seldom cultivated because of the disruption caused by numerous wet depressions and irregular topography. Country residential development is common on the better-drained soils of this unit. Non-farm uses are limited by steep slopes, irregular topography, moderate permeability, stoniness and scattered soil wetness.

## Strathcona (SCO)

This is a thin, very rapidly drained, black grassland soil. It forms on strongly calcareous, poorly sorted, glaciofluvial, ice-contact gravel in agroclimatic zones 2H and 3H. Included with the gravel are large quantities of sand and silt, and numerous angular rock fragments or large boulders. This deposit is often capped by a very thin (< 20 cm), loamy aeolian or fluvial veneer. Strathcona soil occurs on nearly level to strongly sloping glaciofluvial landforms such as eskers, kames, deltas, fans and meltwater scour channels. It is restricted to small areas throughout the central portion of the mapped area.

The natural vegetation consists of grasses such as porcupine grass, blue grama and wheatgrasses. The climate falls within the limits defined for agroclimatic zones 2H and 3H, but varies greatly depending on aspect and landscape position. Precipitation averages 470 mm per year and the frost-free period ranges from 60 to 90 days. The climate is broadly defined because droughtiness resulting from rapid soil permeability restricts use of this soil to a greater extent than does the length of frost-free periods.

A representative profile of Strathcona soil has a thin (10 to 12 cm), black, loamy surface horizon. Below this is a coarse loamy, dark brown to dark yellowish brown oxidized horizon, which often has a high coarse fragment content. Below about 20 to 25 cm, the soil is dominantly composed of gravel-sized material with lesser amounts of sand and silt. A zone of lime accumulation occurs in the upper part of the gravelly material.

All horizons are neutral to moderately alkaline in reaction.

Strathcona soil is very rapidly drained, rapidly pervious and has a low moisture-retention capacity. Most precipitation rapidly infiltrates the soil; thus, surface drainage features are minimal. Strathcona is classified as an Orthic Black Chernozemic soil.

**SCO 1**

This unit is found on upland glaciofluvial landforms. It contains ice-contact gravel deposited in kames, eskers, deltas and fans. Most of the unit is Strathcona soil as described (90 percent). Included when mapping are some soils with more sand and less gravel in the subsoil, and a few lighter-colored eroded patches.

The gravel deposits in this unit are thick and continuous. There is more gravel than sand in the parent material and lenses or pockets of sand are rare. Slopes range from nearly level to strongly sloping.

This unit is generally too droughty and too stony to be cropped. Most areas are used for pasture or exploited for gravel. Since removal of large boulders and included fines may be necessary, SCO 1 areas are only fair to good sources of gravel. Some non-farm uses are limited by rapid permeability and stoniness.

**SCO 2**

This unit is found on upland glaciofluvial landforms. It contains ice-contact gravel and gravelly sand deposited in kames, eskers, deltas, fans and terraces. It consists of variable amounts of gravelly Strathcona soil and other soils that have less gravel, and more sand and silt in their subsoil. About 50 to 70 percent of the unit is Strathcona soil, the remainder being mostly unnamed, black soils with thin topsoil horizons formed on sand or gravelly sand.

The glaciofluvial deposits in this unit are thick, but are also highly variable. They may consist of stratified layers of relatively pure gravel and clean sand, or may be complex mixtures of varying proportions of sand and gravel.

SCO 2 areas are generally too droughty or too stony to be cropped. Most areas are used for pasture or mined for sand and gravel. Non-farm uses may be limited by rapid permeability, stoniness, and sometimes, by steep slopes.

**SCO 3**

This unit is found in glacial meltwater scour channels and cut terraces. About 40 percent of the unit is gravelly Strathcona soil and an equal amount consists of black soils with thin topsoil horizons on sand or gravelly sand. These proportions may change considerably. Some areas are mostly Strathcona soil and others contain mostly sandy soils. The remainder of the unit (20 percent) consists of black soils with thin topsoil horizons developed on stony till, a few soils with bedrock at 60 to 100 cm and some imperfectly to poorly drained soils.

The glaciofluvial deposits in this unit are thin, discontinuous and highly variable. They overlie stony lag-type till and sandstone bedrock. This unit is subject to occasional flooding and periodic high water tables because of its location in drainage channels.

SCO 3 areas are usually small and are too stony, rocky and droughty for crops. They are usually located

in areas used for pasture or watering livestock. They are generally poor to fair aggregate sources. Non-farm uses are limited by stoniness, rapid permeability, shallow depth to bedrock and seasonally high water tables.

## Sundre (SUD)

This is a thin, very rapidly drained, dark gray soil. It forms on strongly calcareous, well-rounded, well-sorted, glaciofluvial outwash gravel in agroclimatic zones 5H and 3H. The gravel is usually capped with a thin (< 50 cm), loamy, aeolian or fluvial veneer. Sundre soil is mapped on level to gently inclined, lower terraces and valley floors of major streams and rivers in the foothills west of Calgary.

The natural vegetation consists of a mixture of grassland and forest. Grasses such as rough fescue, porcupine grass, June grass and wheatgrasses predominate, but most areas are partially treed or have been forested in the past. The most common trees are willow, balsam poplar, aspen and some white spruce. Narrow-leaf cottonwood (*Populus angustifolia*), a locally uncommon species, has been observed along some of the streams where Sundre soil is mapped. Sundre soil is associated with a cool and moist climate. Rainfall averages 570 mm per year, and the frost-free period is less than 60 days.

A representative profile of Sundre soil has a thin, dark gray, loamy surface horizon. Below this is a dark brown to dark yellowish brown, oxidized horizon, which usually contains only a few coarse fragments. The subsoil below about 20 to 40 cm is dominantly gravel-sized material with lesser amounts of sand and silt. A zone of lime accumulation occurs in the upper part of the gravelly parent material. The surface horizon is medium to slightly acidic in reaction, while the subsoil is neutral to moderately alkaline.

Sundre soil is rapidly drained except where a water table exists close to the surface. It is rapidly pervious and has a low moisture-retention capacity. Surface drainage occurs mainly in the channels of active streams and rivers that are associated with this soil. Sundre is classified as an Orthic Dark Gray Chernozemic soil.

### SUD 1

This unit is found on lower terraces and valley floors of major foothill streams and rivers. Most of the unit (80 percent) is Sundre soil as described. Included when mapping are small areas of slightly deeper soil in which gravel is not found above 50 cm, a few soils that are gravelly to the surface and a few wet soils that occur in depressions and along drainage channels.

The gravel deposits in this unit are usually thick and continuous. The water table along valley floors may be relatively shallow and can interfere with gravel recovery operations. Slopes are nearly level to gently inclined except on channel banks and between terraces.

Agricultural use of this unit is severely restricted by the short frost-free season and also by stony and droughty soil conditions. Most areas are used for pasture or mined for gravel. Non-farm uses may be limited by rapid permeability, high potential for groundwater contamination, stoniness and seasonal flooding hazard.

## Terric Mesisol (TM)

This is a broadly defined organic soil unit found in some depressions and valley bottoms south and west of Calgary. Numerous varieties of organic soils are present in these areas, but all are interpreted similarly. Wetness and the organic nature of the soil material are the properties that determine most limitations for use of these areas. Climate may vary, but most areas are considered to display a climate similar to that described for agroclimatic zone 5H. Only one unit was defined for this survey.

### TM 1

This unit occurs in wet depressions and valley bottoms subject to seepage and high groundwater levels. No organic soil series were established that could be used to describe the soils in these areas. In general, most areas have about 100 to 150 cm of mesic peat overlying undifferentiated mineral material. Also included in this unit are variable amounts of peaty Gleysols, mostly found at unit margins, and Typic Mesisols, found in the center of larger organic areas where the thickness of overlying peat exceeds 160 cm. In this unit, all the soils are poorly to very poorly drained. The organic materials average about 100 to 150 cm thick and have a variable rubbed fiber content. Most areas have seasonally high water tables in which groundwater is within 1 m of the surface. The land surface is nearly level to depressional. This unit is too wet, cold and organic to permit normal cultivation. Most areas are unused except for some rough grazing and exist in their natural state. Wetness, high compressibility, low bearing strength, susceptibility to flooding and high water table limit most non-farm uses.

## Tweedsmuir (TWS)

Tweedsmuir is a deep, well to rapidly drained, black grassland soil. It forms on highly variable, recent alluvial deposits in agroclimatic zones 1 and 2H. The alluvium is strongly calcareous, generally contains less than 5 percent coarse fragments and is fine to coarse loamy in texture. Tweedsmuir soil is mapped on level to gently inclined terraces and strongly dissected active channels of streams and rivers east of the foothills.

The natural vegetation is dominated by grasses such as porcupine grass, spear grass, blue grama, wheatgrasses and rough fescue. Most areas of Tweedsmuir soil lie within agroclimatic zone 2H. Precipitation averages 400 mm per year and the frost-free period is 75 to 90 days.

A representative profile of Tweedsmuir soil has a black, loamy surface horizon 13 to 18 cm thick. Below this is a weakly structured, brownish oxidized horizon. The parent material begins at about 30 to 50 cm, is weakly bedded, has a wide variation in texture and

related properties, and generally contains between 6 to 20 percent free lime. The surface horizon is neutral to mildly alkaline in reaction, and the subsoil is moderately alkaline.

Tweedsmuir soil is rapidly drained and moderately to rapidly pervious. It has a medium moisture-retention capacity. Surface drainage is usually dominated by a central stream channel, but numerous abandoned channels and transverse gullies may exist.

Tweedsmuir is classified as an Orthic Black Chernozemic soil. Included with Tweedsmuir when mapping are some weakly developed soils that lack subsurface oxidized horizons (Rego Black). Soils that contain several buried topsoil layers are also included. They are classified as Cumulic Regosol if they have less than 10 cm of black topsoil at the surface, and as 'Cumulic' Rego Black Chernozemic if the topsoil exceeds 10 cm.

**TWS 1**

This unit is found on well-drained upper terraces along streams, rivers and natural drainage ways east of the foothills. Most of the unit (70 percent) is Tweedsmuir soil as described. Included when mapping are some soils with weak profile development (20 percent) and a few cumulic soils with buried topsoil horizons. There are occasional spots of wet soil and a few profiles with a gravelly subsoil.

The soils in this unit are almost all well drained. The alluvial parent material is consistently more than 1 m thick, but it has a wide natural range in texture and related properties. The land surface is nearly level to gently inclined and is not strongly dissected.

Large areas of the unit are often cultivated, and all locally common crops, except wheat, are grown. The most frequent use is for pasture or forage. The frost-free period is a slight limitation to use of these areas. Seasonal flooding and surrounding rough topography may be additional limitations. Non-farm uses may be limited by seasonal flooding hazard, high potential for groundwater contamination and high frost heave potential.

**TWS 2**

This unit is found on well to poorly drained, strongly dissected lower terraces and stream channels east of the foothills. About 40 percent of the unit is Tweedsmuir soil. About 30 percent consists of well-drained soils that are weakly developed or cumulic and show evidence of repeated flooding. The remaining 30 percent of the unit is poorly drained soil that occurs in depressions, along active stream channels and in abandoned drainage ways.

This unit is more variable than TWS 1. It contains more wet and flooded soils. The alluvial parent material also tends to have a wider range of texture and related properties than in TWS 1. In addition, the land surface is much rougher than in TWS 1, due to dissection by active and abandoned stream channels.

TWS 2 unit is rarely cultivated. The short frost-free season is a moderate limitation. Additional limitations are imposed by the strongly dissected topography, numerous channels and wet soils, and the high seasonal flooding hazard. Most areas are in pasture and are used for grazing and livestock watering. Non-farm uses are adversely affected by the seasonally high water table and flooding hazard, dissected topography, high potential for contamination of surface and groundwater, and high frost heave potential.

## Twin Bridges (TBR)

Twin Bridges is an imperfectly drained, weakly developed, Alluvial soil. It forms on highly variable, recent fluvial deposits. The alluvium is extremely calcareous and has a sandy to coarse loamy texture. It generally contains less than 5 percent coarse fragments. This soil is mapped along the strongly dissected valley floor of the Elbow River west of Calgary.

Twin Bridges soil supports a forest vegetation consisting of white spruce, willow, aspen and balsam poplar. The climate is cool and moist (5H). Precipitation averages 570 mm per year and the frost-free period is less than 60 days.

A representative profile of Twin Bridges soil has a calcareous, weakly developed dark grayish brown surface horizon, 8 to 12 cm thick. Beneath this, the parent material is mottled below about 70 cm. The parent material has no structure except for occasional, weak bedding. It is extremely calcareous and is highly variable in texture. All horizons of this soil are mildly to moderately alkaline.

Twin Bridges is imperfectly drained, but is moderately to rapidly pervious. Restricted drainage results from a high water table, not from ponding of surface water. The moisture-retention capacity of this soil is low to medium, and seldom presents any limitations to use because of the availability of water below the shallow water table. Surface drainage is dominated by the central river channel, but there are numerous secondary channels, both abandoned and active, as well as meander scars, depressions and gullies.

Twin Bridges is classified as a Gleyed Humic Regosol. Some soils included when mapping have prominent mottling at shallow depths. They are classified as Rego Humic Gleysols. A few have no mottling within the top 1 m of soil and are classified as Orthic Humic Regosols. Also included are soils with little or no profile development that are formed on gravel and classified as Orthic Regosols.

**TBR 1**

This is the only unit of Twin Bridges soil mapped in the area. It is found along the imperfectly drained, strongly dissected floor of the Elbow Valley. It contains a complex mixture of soils and parent materials. About 50 percent of the unit is Twin Bridges soil and about 30 percent is recently deposited gravel, which shows only weak soil development. The remaining 20 percent is mostly wet soil formed on the same variable-textured alluvium as Twin Bridges.

The water table is high throughout this unit, as the alluvium and gravel are built up only slightly above the flow level of the river. The gravel usually occurs in a braided pattern of ribbons and bars associated with

abandoned channels, while the alluvium covers the remainder of the area. The topography is nearly level, except for ridges and channels created by stream dissection and gravel deposition.

This unit is not used for cultivation. The frost-free period is too short, the soils too damp and cold or too stony, and the seasonal flooding hazard too high to justify clearing for cultivation. Most areas are forested and are used for woodland grazing. They provide shelter and ready access to water for livestock. Non-farm uses are limited by seasonal flooding hazard, high water table and high potential for surface and groundwater contamination. There may also be a high frost heave hazard for roads and structures.

# Part IV - Interpretation of soils of the Calgary urban perimeter

In this section, the soils described in the preceding chapter (Part III) are interpreted for various potential uses considered relevant to the purposes of the survey. Each of the 105 soil units recognized and mapped in this area differs in some way from all other units. All of the units, to a varying degree, have different management requirements, land-use capabilities and yield potential. Many soil units, however, have certain similarities that allow them to be grouped together in estimating their suitabilities or limitations for particular uses.

These groupings are based on evaluations of data accumulated during the soil survey and on related applied research and experience. All interpretations are derived from soil ratings based on the properties and characteristics of the soil units as previously described. The criteria used to evaluate the units differ for each potential use. Some of the more commonly used criteria are slope, drainage, perviousness, texture, engineering classification, pedological classification, stoniness and depth to bedrock. This section contains tables which detail the guidelines used to arrive at each interpretation (see tables 14 to 26).

## How to use the soil maps and interpretations tables

The four soil maps of the Calgary urban perimeter are included in a pocket at the back of this report. Each outlined area on a map contains a notation indicating the soil unit and phase that best describes the particular area. This notation acts as a key, which allows the user to locate a description of the area in the legend and in the report.

Interpretations have been made for each unique soil unit notation found on the maps. Thus, a user has only to determine the symbol which describes a particular area of interest and then locate that symbol in the appropriate interpretations table. All soil unit symbols are arranged alphabetically within the tables to allow for easy location. In order to fully understand the interpretations for any unit, it is recommended that the user read carefully the description of that unit found in the preceding chapter. The descriptions provide information about the complexity of soils and parent materials found within the units, and include statements relating to the variability of important unit properties.

**Computer-derived interpretive maps**

It has been possible to produce computer-derived, single factor, interpretive maps for all interpretations undertaken by this survey. This was accomplished through replacement, by the computer, of each unique symbol on the original map with its corresponding rating for a particular use. These maps allow the user to read the interpretation directly, once he has located an area on the map. It is, however, impractical to publish and distribute 64 separate maps, which are required to interpret all 4 map areas for all 16 interpretations. Consequently, reproduceable copies of each interpretive map have been produced and are on file at the Alberta Research Council. One such derived map has been included in the rear pocket as an example.

**Limitations in the use of this map and report**

The user is cautioned against uncritical acceptance of the information contained on the map and of interpretations based on it. In a previous section describing soil mapping techniques, it was noted that more than 99 percent of the area covered by a soil map is never investigated below the surface. Thus, most of each outlined area is described on the basis of a few observations within that area. Obviously, soils may exist within a delineation that may not have been encountered during investigations of that area. These soils may differ considerably from those that are described as having been found in the area. Thus, the map is not intended to show site specific data and should not be used in lieu of site investigations. For design purposes, a site investigation by specialists should always be made. The information given here, however, can be used for general assessment and, for the specialist, it should prove to be an excellent guide for planning effective investigations.

**Kinds of soil interpretations**

This survey covers an area characterized by the presence of rural farmland surrounding a rapidly expanding urban center. In this rural-urban interface, a wide variety of users require soils information to help them assess the suitability of soil areas for a broad spectrum of potential uses. In the following sections, interpretive soil information is provided in tabular form for the following land use evaluations.

1. Agricultural interpretations

- Canada Land Inventory soil capability classification for dryland agriculture.
- Estimates of soil erodibility.
- Estimates of probable yields of common crops.

2. Non-agricultural (pedotechnical) interpretations
   - Suitability as a source of: topsoil, sand and gravel, roadfill.
   - Suitability and limitations as sites for: road location, buildings with basements, urban services, septic tank absorption fields, sanitary landfills, reservoir sites, flooding hazard.
   - Recreational site suitability and limitations for: camp areas, picnic areas, paths and trails.

The guidelines used to arrive at these evaluations are briefly discussed in the following section. Much of this information is extracted from a recent compilation of soil interpretation guidelines prepared by Greenlee (1981) and from tables appearing in unpublished USDA, Soil Conservation Service, handbooks.

These interpretations are intended only to serve as guides for planners and managers. They are not intended as recommendations for land use and do not eliminate the need for on-site evaluations by qualified professionals.

## Agricultural interpretations

Assessments have been done of the soil capability for dryland agriculture, erosion potential (table 11a) and estimated probable yields for crops common to the area (table 11b). The criteria and methodology used to arrive at these assessments are discussed below.

### Soil capability classification for dryland agriculture

In this classification, mineral soils are grouped into seven classes based on their limitations for dryland farming. The first three classes are considered capable of sustained production of common field crops, the fourth class is marginal for sustained arable agriculture, the fifth class is capable of use only for improved permanent pasture, the sixth class is capable of use only for wild pasture, and the seventh class is for soils and land types considered incapable of use for arable agriculture or permanent pasture. Although the soils in classes one to four are capable of use of cultivated field crops, they are also capable for use as permanent pasture. Soils in all classes may be suitable for forestry, wildlife and recreational uses. Soils in classes 4 to 7 are not necessarily non-productive. They are simply restricted in the range of crops that they can support or present management problems that make them difficult or expensive to use.

*Basic assumptions of classification system*

This soil capability classification contains the following assumptions:

1. It is an interpretive classification based on the effects of combinations of climate and soil characteristics and their general productive capacity for common field crops.
2. Soils will be well managed and cropped, using a largely mechanized system of agriculture.
3. Soils within a capability class are similar in degree but not kind of limitation. Each class includes many different kinds of soils, and many soils within one class require different management.
4. Soils considered feasible for improvement by practices that can be made economically by the farmer are classified by their limitations after the improvements are made. Soils requiring improvements beyond the means of the individual operator are classified by their present condition.
5. Distance to market, kind of roads, location, size of farms, characteristics of land ownership, cultural patterns and the skill or resources of individual operators are not criteria for capability groupings.
6. Capability groupings are subject to change as new information about the behavior and responses of the soils becomes available.

*Structural organization of classification system*

The capability classification consists of two main categories: the capability class and the capability subclass.

1. *The capability class*, the broadest category, is a grouping of soils that have the same relative degree of limitation or hazard for agricultural use. The limitation becomes progressively greater from Class 1 to Class 7. The seven capability classes are:
   - Class 1 - Soils in this class have no substantial limitations in use for crops.
   - Class 2 - Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.
   - Class 3 - Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices.
   - Class 4 - Soils in this class have severe limitations that restrict the range of crops or require special conservation practices or both.
   - Class 5 - Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops and improvement practices are feasible.
   - Class 6 - Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible.
   - Class 7 - Soils in this class have no capability for arable agriculture or permanent pasture.
2. *The capability subclass* is a grouping of soils with similar kinds of limitations and hazards affecting agricultural use of soils. The subclass limitations encountered in the Calgary areas are listed below:
   - Subclass C: adverse climate.
   - Subclass D: undesirable soil structure or low permeability.
   - Subclass E: actual erosion damage.
   - Subclass I: inundation (flooding by streams and lakes).

- Subclass M: low moisture-holding capacity.
- Subclass N: adverse soil salinity.
- Subclass P: adverse stoniness.
- Subclass R: shallowness to solid bedrock.
- Subclass S: a combination of two or more of the limitations D, F, M and N.
- Subclass T: adverse topography.
- Subclass W: excess water.
- Subclass X: minor cumulative limitations.

**Application of soil capability ratings to soil units**

Each symbol that appears on the map corresponds to a particular assemblage of soils and landscape features that can be rated according to the system described above. Some areas contain a uniform grouping of soils and soil phases and can be evaluated as belonging to a single capability class (e.g., 2T). Other areas contain a more complex mixture and must be evaluated in terms of the various different soils included in that unit. For example:

$$1^{4}3_{D}{}^{3}5_{W}^{N3}$$

would be used to denote an area that contains 40 percent class 1 soil with no limitations, 30 percent class 3 soil which is limited by adverse structure and 30 percent class 5 soil limited by adverse salinity and soil wetness.

The appropriate capability rating for each soil unit/phase notation can be found in table 11a. Those users interested in determining the capability ratings for many areas might wish to obtain the computer-derived soil capability for agriculture maps discussed on page 74.

**Estimates of susceptibility to soil erosion**

Soil erosion is controlled by many factors, some of which are related to internal soil characteristics while others are completely external (plate 34). In the case of water erosion, some important external controlling factors cannot be accurately forecast from information contained on the soil map. These include such attributes as the nature of the vegetative cover, local rainfall intensity and frequency, slope length and orientation or crop management practices. Quantitative estimates of potential soil erosion losses cannot be made since values for these factors are not known and cannot be predicted based on information available on the soil map.

**Plate 34.** Soil erosion during a wind storm east of Calgary

Since actual soil losses cannot be estimated, the practical alternative is to produce a rating of the comparative inherent erodibility of soils based on those properties that can be predicted. The most commonly used measure of comparative soil erodibility is the K factor as determined by the method of Wishmeier et al. (1971). This method considers the cumulative effects of soil texture, organic matter content, structure and permeability and produces a decimal rating between the values of 0.0 and 0.7. Coen et al. (1977) has modified this method to include the effects of slope angle as originally proposed by Rutter (1968).

For this report, the K values were determined for the surface and subsurface horizons of all major soils. These values were then applied to the slope angle rating chart (table 23) to determine the relative erodibility rating (table 11a) of a given soil unit and slope phase.

**Estimates of probable yields of common crops**

Predicted average yields of the principal crops grown in the Calgary urban perimeter area under a dryland farm management system were calculated (table 11b). They are based on historical records of actual yields obtained from the records of the Alberta Hail and Crop Insurance Corporation. These yield data were first cross-tabulated against the principal soil units mapped in each section of land for which data were available. This cross-tabulation procedure unfortunately resulted in the production of too few yield records for each soil unit to allow meaningful analysis. The only breakdown that produced a sufficient number of records to allow for computation of average yields involved segregation at the soil group level. Consequently, at the present time, predictions of likely average yields of common crops in the Calgary area can only be made for some of the major soil groups within the area. These estimates are very general and are meant only to give an idea of the average yields typically found within some soil groups.

Comparisons of crop yields by soil group are complicated by the use of different cropping rotations, fertilizer rates and management practices. Historical records of yield reflect, in large measure, farming practices that may no longer be in use. These predictions cannot be expected to reflect future substantial advances in agronomic practice or plant breeding. They are useful mainly for comparing the probable yields of different crops on the different kinds of soil found in the Calgary area.

## Non-agricultural (pedotechnical) interpretations

This section contains information which can be of value to engineers, land use planners and others interested in predicting the likely behavior of soil units for various engineering type uses. Agricultural soil

surveys are often referred to by engineers as pedological surveys to distinguish them from their own evaluations of soil as an engineering material. Pedological surveys, however, have been found to provide considerable information that can be useful for engineering evaluations.

**The engineering significance of pedological surveys**

The procedures used in making pedological surveys include considerations of the soil as it is found in place. They include not only the parent materials, but also the effects of soil climate, drainage, surface form, slope, hydrologic environment and other landscape features. The resulting maps are among the most comprehensive sources of information about the near surface environment currently available. In addition, when making the soil survey, the pedologist is also very much interested in the underlying materials, including bedrock, that constitute the geologic environment. Considerable information regarding the geologic environment can be obtained from the soil unit descriptions. Those interested in more-detailed descriptions of the distribution of geologic materials and their stratigraphic relationships are directed to a recent Alberta Geological Survey publication covering the same areas as this study (Moran, 1986). There is no conflict here between geology and pedology; rather, one science complements the other, and for those concerned with making geotechnical evaluations, both sources of information should prove useful.

**Pedotechnical information for engineers and technical planners**

Pedological surveys are usually of the top 1 to 2 m of soil material and can provide valuable information to the engineer or technical planner concerned with the upper layers of the soil. Some examples of near-surface engineering concerns include:

1. Urban engineering - shallow foundations, septic tanks
2. Hydraulic engineering - watershed control of runoff and drainage
3. Environmental engineering - surface disposal of sewage sludge
4. Corrosion engineering - pipelines, concrete foundations
5. Construction engineering - search for sand, gravel or topsoil
6. Transportations engineering - transportation routes (highways, railways, transmission lines)

A professional engineer, working in one or more of these fields, will likely want to make his own interpretations of the soil units based on an evaluation of the data provided. Such users should read the appropriate soil unit descriptions to obtain an understanding of the pedotechnical setting common to the units. They should then consult the tables of engineering data and estimated engineering behavior included in Appendix A for those soil series that are listed as occurring within the units being examined. This should provide them with a good appreciation of the conditions they can expect to encounter when conducting on-site investigations and site analyses.

**Interpretations ratings for land-use planners**

For specialists in the field of land-use planning, the information contained in the interpretations tables (tables 12 and 13) following this section may be more relevant. It is assumed that information is preferred in the form of ratings and recommendations rather than as data for design. Planners are advised to consult the interpretations tables or to obtain single-factor derived maps in order to determine the suitabilities and limitations of specific soil units for various land uses. These interpretations are based on criteria outlined in tables 14 through 26. Some planners may wish to modify these criteria and the resulting interpretations to have them conform to their particular needs or planning philosophies. They are encouraged to do so, as the guidelines presented are not immutable, but are simply the best available at the present time. The guidelines are adapted from various sources with experience in soil survey throughout Canada and the United States. The interpretations are simply estimates of the likely behavior of soil units based on the experiences of those individuals who determined the guidelines. They are not recommendations for land use; rather, they should be viewed as inputs into the planning process. The planner can use interpretations to help predict the type and degree of potential problems and to plan the kind and amount of on-site investigation needed.

**Definitions of the soil interpretation classes**

The following ratings have been used to describe the relative degree of suitability or limitation of the various soil units for any given non-agricultural use. The ratings are generally determined by the most limiting property that affects the unit as set out in the table of guidelines. Less-severe limitations may also be present and may require consideration. In the interpretations tables, the ratings are usually qualified by one to three phrases, which explain the source of the most serious limitations. The rating definitions and most of the tables of guidelines are extracted from a recently published soil interpretations guidebook compiled by Greenlee (1981).

*None to slight*

A none to slight soil limitation is the rating given soils that have properties favorable for the rated use. The degree of limitation is minor and can be easily overcome. Good performance and low maintenance can be expected.

*Moderate*

A moderate soil limitation is the rating given soils that have properties moderately favorable for the rated use. This degree of limitation can be overcome or modified by special planning, design or maintenance. During some part of the year, the performance of the planned use is somewhat less desirable than for soils rated

slight. Some soils rated moderate require treatment such as artificial drainage, runoff control to reduce erosion, extended sewage absorption fields, extra excavation, or some modification is needed for construction plans generally used for soils of slight limitation. Modification may include special foundations, extra reinforcement of structures, sump pumps and the like.

*Severe*
A severe soil limitation is the rating given soils that have one or more properties unfavorable for the rated use, such as steep slopes, bedrock near the surface, flooding hazard, high shrink-swell potential, a seasonal high water table, or a sandy surface texture. This degree of limitation generally requires major soil modification, special design or intensive maintenance. Modification might require the soil material to be removed or replaced. Some of these soils can be improved by reducing or removing the soil feature that limits its use, but in most situations it is difficult and costly to alter the soil or design a structure so as to compensate for a severe degree of limitation.

*Very severe*
A very severe limitation is the rating given soils that have one or more properties that are so unfavorable for the proposed use that the soils cannot physically be used for that purpose or it is thought to be economically impractical to do so. Examples of such properties are very steep slopes, bedrock very near the surface, frequent flooding, permanently wet soils, excessively stony soils or organic soils.

*Good*
A rating of good means the soils have properties favorable for the rated use. Good performance and low maintenance can be expected.

*Fair*
A rating of fair means the soils are moderately favorable for the rated use. One or more soil properties make these soils less desirable than those rated good.

*Poor*
A rating of poor means the soils have one or more properties unfavorable for the rated use. Overcoming the unfavorable property requires special design, extra maintenance or costly alteration.

*Very poor*
A rating of very poor means the soils have one or more properties that are so unfavorable for the proposed use that the soils cannot physically be used for that purpose or it is thought to be economically impractical to do so.

**Table 11a.** Agricultural interpretations of the study area soil units.

| Soil unit | Slope phase | CLI capability for agriculture | Erosion rating | |
|---|---|---|---|---|
| | | | Surface soil | Exposed subsoil |
| ADHP 1 | c | $2^{5}_{T}3^{M5}_{E}$ | low | low |
| ADHP 1 | d | $3^{5}_{T}4^{M5}_{T}$ | low | low-moderate |
| ADHP 2 | d | $3^{5}_{T}4^{M3}_{T}4^{2}_{W}$ | low | moderate |
| ADHP 3 | d | $3^{4}_{T}4^{M4}_{T}4^{T2}_{E}$ | moderate | moderate |
| ADHP 3 | e | $4^{4}_{T}5^{T4}_{E}5^{T2}$ | moderate | moderate |
| ADHP 3 | f | $5^{T6}6^{T4}_{E}$ | moderate-high | moderate-high |
| ATL 1 | c | $2_{C}$ | low | moderate |
| ATL 1 | d | $3_{T}$ | low-moderate | moderate-high |
| ATL 1 | e | $4_{T}$ | moderate | high |
| ATL 2 | c | $2^{8}_{C}4^{2}_{W}$ | low | moderate |
| ATL 2 | d | $3^{8}_{T}4^{2}_{W}$ | low-moderate | moderate-high |
| ATL 3 | d | $3_{T}$ | low-moderate | moderate-high |
| ATL 3 | e | $4_{T}$ | moderate | high |
| ATL 3 | f | $5_{T}$ | moderate-high | high |
| ATL 5 | c | $3^{E}_{T}$ | low-moderate | moderate-high |
| ATL 5 | de | $4^{T}_{E}$ | moderate | high |
| BED 1 | c | $3_{D}$ | low | moderate |
| BED 2 | c | $3^{6}_{D}2^{4}_{T}$ | low | moderate |
| BED 3 | c | $3^{4}_{D}5^{N3}_{W}2^{3}_{T}$ | low-moderate | moderate |
| BOV 1 | b | $4^{M}_{P}$ | low | low |
| BOV 1 | c | $4^{M}_{P}$ | low | low |
| BOV 2 | f | $6^{T}_{P}$ | moderate | moderate |
| BPW 1 | d | $4^{T}_{E}$ | moderate | moderate-high |
| BRG 1 | b | $5_{C}$ | moderate | low |
| BZC 1 | a | $5^{N}_{W}$ | low | low |
| BZC 2 | bd | $5^{N7}_{W}4^{T3}_{E}$ | low | low |
| BZC 3 | b | $5^{N}_{W}$ | low | low |
| BZC 4 | bc | $5^{7}_{W}2^{3}_{T}$ | low | low |
| CON 1 | d | $5_{C}$ | moderate | moderate |
| DEL 1 | b | $1$ | low | low |
| DEL 1 | c | $1$ | low | moderate |
| DEL 1 | d | $2_{T}$ | low-moderate | moderate |
| DEL 2 | c | $1^{8}5^{N2}_{W}$ | low | moderate |
| DEL 3 | c | $2^{6}_{T}5^{N4}_{W}$ | low | moderate |
| DEL 4 | c | $1^{6}3^{2}_{D}2^{2}_{E}$ | low | moderate |
| DEL 5 | c | $2^{4}_{T}3^{3}_{D}5^{N3}_{W}$ | low | moderate |
| DEL 6 | b | | | |
| DEL 6 | c | $1^{7}3^{W3}_{I}$ | low | moderate |
| DEL 7 | c | $2^{5}_{T}3^{T5}_{E}$ | moderate | moderate |
| DEL 7 | d | $3^{5}_{T}4^{T5}_{E}$ | moderate | moderate |
| DEL 8 | db | $3^{T6}_{E}4^{W4}_{I}$ | moderate | moderate |
| DEL 9 | d | $3^{T}_{E}$ | low | moderate |
| DEL 9 | e | $4^{T}_{E}$ | moderate-high | moderate |
| DERK 1 | b | $1^{7}2^{3}_{M}$ | low | low |
| DERK 1 | c | $1^{7}2^{3}_{M}$ | low | moderate |

**Table 11a.** (continued)

| Soil unit | Slope Phase | CLI capability for agriculture | Erosion rating | |
|---|---|---|---|---|
| | | | Surface soil | Exposed subsoil |
| DERK 1 | d | $2^{7}_{T}3^{M3}_{T}$ | moderate | moderate |
| DERK 2 | b | $2^{7}_{T}3^{W3}_{I}$ | moderate | low |
| DERK 2 | c | $2^{7}_{T}3^{W3}_{I}$ | moderate | moderate-low |
| DVFS 1 | d | $3^{8}_{C}6^{2}_{W}$ | low | moderate |
| DVFS 1 | e | $4^{8}_{T}6^{2}_{W}$ | moderate | moderate-high |
| DVFS 2 | e | $4^{8}_{T}6^{2}_{W}$ | moderate | moderate-high |
| DVG 1 | c | $3_{C}$ | low | moderate-low |
| DVG 1 | d | $3_{C}$ | low-moderate | moderate |
| DVG 1 | e | $4_{T}$ | moderate | moderate |
| DVG 2 | c | $3^{8}_{C}4^{2}_{W}$ | low | moderate-low |
| DVG 2 | d | $3^{8}_{C}4^{2}_{W}$ | low-moderate | moderate |
| DVG 3 | e | $4_{T}$ | moderate | moderate |
| DVG 3 | fg | $6^{T}_{E}$ | high | high |
| DVG 4 | d | $4_{T}$ | moderate-high | moderate |
| DWHP 1 | b | $4^{6}_{W}3^{M4}_{T}$ | low | low |
| DWHP 1 | c | $4^{6}_{W}3^{M4}_{T}$ | low | low |
| DWT 1 | ab | $4_{W}$ | low | low-moderate |
| DWT 2 | a | $4_{W}$ | low | low-moderate |
| DWT 3 | a | $6^{W}_{I}$ | low | low |
| EBAD 1 | c | $2^{7}_{E}3^{3}_{M}$ | low-moderate | moderate |
| EBAD 2 | d | $3^{E7}_{T}4^{M3}_{T}$ | moderate | moderate-low |
| ELRS 1 | c | $5_{C}$ | low | low-moderate |
| ELRS 1 | d | $5_{C}$ | low-moderate | moderate |
| ELRS 1 | e | $6_{T}$ | moderate | high |
| ELRS 3 | c | $5_{C}$ | low | low-moderate |
| ELRS 3 | e | $6_{T}$ | moderate | high |
| ELRS 3 | fg | $6_{T}$ | high | high |
| ELRS 4 | cd | $5_{C}$ | low-moderate | moderate |
| FSH 1 | b | $4_{S}$ | low | low |
| FSH 1 | c | $4_{S}$ | low | low |
| FSH 1 | d | $4_{S}$ | low-moderate | moderate |
| FSH 2 | b | $4^{8}_{S}4^{2}_{W}$ | low | low |
| FSH 2 | c | $4^{8}_{S}4^{2}_{W}$ | low-moderate | low-moderate |
| FSH 2 | d | $4^{8}_{S}4^{2}_{W}$ | moderate | moderate |
| FSH 3 | c | $4_{S}$ | low | low |
| FSH 3 | d | $4_{S}$ | low-moderate | moderate |
| FSH 4 | cd | $4^{8}_{S}4^{2}_{W}$ | moderate | moderate |
| FSH 5 | d | $5_{C}$ | low-moderate | moderate |
| HIBO 1 | b | $2^{5}_{M}4^{M5}_{P}$ | low | low |
| HIBO 1 | c | $2^{5}_{M}4^{M5}_{P}$ | low | low |
| HIW 1 | b | $2_{M}$ | low | low |
| HIW 1 | c | $2_{M}$ | low | low |
| HPAD 1 | c | $3^{4}_{M}2^{4}_{M}1^{2}$ | moderate-low | moderate-low |
| HPAD 1 | d | $4^{M4}_{T}3^{M4}_{T}2^{2}_{T}$ | moderate | moderate |
| HPAD 3 | d | $4^{M}_{T}$ | moderate | moderate |

**Table 11a.** (continued)

| Soil unit | Slope phase | CLI capability for agriculture | Erosion rating | |
|---|---|---|---|---|
| | | | Surface soil | Exposed subsoil |
| HPAD 3 | e | $5^{T}_{M}$ | moderate-high | moderate |
| HPAD 4 | e | $5^{T}_{M}$ | moderate-high | moderate |
| HPV 1 | cb | $3_{M}$ | moderate-low | moderate-low |
| HPV 2 | d | $4^{M}_{T}$ | moderate | moderate |
| HPV 2 | e | $5^{T}_{M}$ | moderate | moderate |
| HPV 3 | d | $5^{T}_{M}$ | moderate | moderate |
| HPSC 1 | d | $4^{M7}_{T}5^{M3}_{P}$ | moderate | moderate |
| IND 1 | ab | $3^{W}_{I}$ | low | low |
| IND 2 | b | $3^{W6}_{I}2^{4}_{T}$ | low | low |
| IND 2 | c | $3^{W6}_{I}2^{4}_{T}$ | low | low |
| LLK 1 | b | $2_{C}$ | low | low |
| LLK 1 | c | $2_{C}$ | low | moderate |
| LLK 1 | d | $3_{T}$ | low | moderate |
| LLK 2 | b | $2^{4}_{C}3^{4}_{D}5^{N2}_{W}$ | low | low |
| LLK 3 | d | $3_{T}$ | low | moderate-high |
| LLK 3 | e | $4_{T}$ | moderate | moderate-high |
| LLK 3 | f | $6^{T}_{E}$ | moderate | high |
| LLK 4 | c | $3_{C}$ | low | moderate |
| LTC 1 | e | $5^{T}_{D}$ | low-moderate | moderate-high |
| LTC 1 | f | $6^{T}_{D}$ | moderate | high |
| LTC 1 | g | $6^{T}_{D}$ | high | high |
| LTC 2 | c | $4_{D}$ | low | low-moderate |
| LTC 2 | d | $4_{D}$ | low | moderate |
| MDAD 1 | c | $2^{6}_{M}1^{4}$ | low | moderate |
| MDAD 1 | d | $3^{M6}_{T}2^{4}_{T}$ | low | moderate |
| MDP 1 | c | $2_{M}$ | low | moderate |
| MDP 2 | d | $3^{M}_{T}$ | low | moderate |
| MDP 2 | d | $3^{M7}_{T}4^{3}_{W}$ | low | moderate |
| MD-L 1 | c | $4_{M}$ | low | moderate |
| MSB 1 | f | $6^{T}_{R}$ | moderate | high |
| MSB 1 | gh | $6^{R5}_{T}7^{R5}_{T}$ | high | high |
| NSK 1 | c | $3^{S}_{P}$ | low | low-moderate |
| NSK 2 | bd | $4^{S5}_{T}4^{N5}_{W}$ | low-moderate | moderate |
| NSK 3 | b | $4^{S5}_{T}4^{3}_{D}5^{N2}_{W}$ | low | low-moderate |
| POT 1 | ab | $6_{W}$ | low | low |
| POT 2 | ab | $6^{6}_{W}5^{S4}_{T}$ | low | low |
| POT 2 | c | $6^{6}_{W}5^{S4}_{T}$ | low | low |
| POT 3 | bd | $6^{W}_{I}$ | low | low |
| RB 1 | e | $5_{T}$ | moderate | moderate-high |
| RB 1 | f | $6_{T}$ | moderate | high |
| RB 1 | gh | $6_{T}$ | moderate-high | high |
| RB 2 | f | $6^{T}_{R}$ | moderate-high | high |
| RB 2 | gh | $6^{T5}_{R}7^{R5}_{T}$ | high | high |
| RB 4 | de | $5^{T}_{I}$ | low-moderate | moderate |
| RB 4 | f | $6^{T}_{I}$ | moderate | moderate-high |

**Table 11a.** (continued)

| Soil unit | Slope phase | CLI capability for agriculture | Erosion rating | |
|---|---|---|---|---|
| | | | Surface soil | Exposed subsoil |
| RB 4 | gh | $6^{T}_{I}$ | moderate-high | high |
| RB 5 | f | $6_{T}$ | moderate-high | high |
| RB 5 | gh | $6^{5}_{T}7^{T5}_{E}$ | high | high |
| RKAD 1 | c | 1 | low | low-moderate |
| RKAD 1 | d | $2^{7}_{T}3^{T3}_{E}$ | moderate | moderate-high |
| RKAD 2 | c | $1^{5}2^{3}_{E}5^{N2}_{W}$ | low | low-moderate |
| RKAD 2 | d | $2^{5}_{T}3^{T3}_{E}5^{N2}_{W}$ | moderate | moderate-high |
| RKAD 3 | d | $3^{T}_{E}$ | moderat | moderate-high |
| RKAD 3 | e | $4^{T}_{E}$ | moderate-high | high |
| RKAD 4 | c | $1^{6}2^{2}_{E}3^{2}_{D}$ | low | low-moderate |
| RKAD 5 | c | $2^{5}_{T}3^{T5}_{E}$ | moderate | moderate |
| RKAD 5 | d | $3^{5}_{T}4^{T5}_{E}$ | moderate | moderate-high |
| SCO 1 | c | $5^{M}_{P}$ | low | low |
| SCO 1 | d | $6^{T}_{M}$ | low | low |
| SCO 2 | dc | $5^{M}_{T}$ | low | low |
| SCO 2 | e | $6^{T}_{M}$ | low-moderate | low-moderate |
| SCO 3 | bc | $5^{M}_{P}$ | low | low |
| SCO 3 | de | $6^{T}_{M}$ | low-moderate | low-moderate |
| SPR 1 | d | $5_{C}$ | moderate | moderate |
| SPR 1 | e | $6_{T}$ | moderate-high | moderate-high |
| SPR 1 | f | $6_{T}$ | high | high |
| SPR 1 | gh | $6^{5}_{T}7^{R5}_{T}$ | high | high |
| SPR 2 | d | $5_{C}$ | low-moderate | moderate |
| SPR 2 | e | $6_{T}$ | moderate | moderate-high |
| SPR 2 | fg | $6_{T}$ | moderate-high | high |
| SPY 1 | d | $4^{9}_{T}4^{1}_{W}$ | low | moderate |
| SPY 1 | e | $5^{9}_{T}4^{1}_{W}$ | low-moderate | moderate-high |
| SPY 1 | fg | $6^{9}_{T}4^{1}_{W}$ | moderate | high |
| SPY 2 | d | $4^{7}_{T}4^{3}_{W}$ | low | moderate |
| SPY 2 | e | $5^{7}_{T}4^{3}_{W}$ | low-moderate | moderate-high |
| SPY 2 | f | $6^{7}_{T}4^{3}_{W}$ | moderate | high |
| SRC 1 | b | $3_{C}$ | moderate | low |
| SRC 2 | bd | $4^{T5}_{I}6^{W5}_{I}$ | moderate | low-moderate |
| SRC 3 | b | $4_{M}$ | moderate | low |
| SRC 4 | bd | $4^{6}_{M}6^{W4}_{I}$ | moderate | low-moderate |
| SUD 1 | b | $4^{M}_{P}$ | low | low |
| TBR 1 | bd | $5^{I}_{W}$ | low-moderate | moderate |
| TM 1 | a | 0 | low | low |
| TWS 1 | bc | $2_{C}$ | low-moderate | low-moderate |
| TWS 1 | d | $3_{T}$ | moderate | moderate |
| TWS 2 | bd | $3^{5}_{T}4^{W5}_{I}$ | low-moderate | low-moderate |

**Table 11b.** Estimates of probable yields of common crops in the Calgary urban perimeter survey area for some Calgary area soil units. Yields kg/ha.

| Soil symbol | Crop | No. of records | Overall | Fertilized | Non-fertilized | Stubble | Fallow |
|---|---|---|---|---|---|---|---|
| ATL 1 | Barley | 262 | 2407 | 2497 | 2336 | 2230 | 2937 |
| | | | | (322) | (49) | (241) | (129) |
| ATL 1 | Oats | 64 | 2288 | 2315 | 2315 | 2126 | 2431 |
| | | | | (56) | (30) | (51) | (35) |
| BZC 1 | Barley | 35 | 1938 | 2112 | | 1878 | |
| | | | | (49) | (0) | (36) | (13) |
| DEL 1 | Wheat | 370 | 2214 | 2249 | 2190 | 1913 | 2455 |
| | | | | (484) | (60) | (216) | (327) |
| DEL 1 | Barley | 647 | 2321 | 2379 | 2236 | 2069 | 2748 |
| | | | | (974) | (102) | (611) | (462) |
| DEL 1 | Oats | 101 | 1907 | 2092 | | 1709 | 2578 |
| | | | | (167) | (13) | (105) | (75) |
| DEL 1 | Rapeseed | 230 | 1237 | 1235 | 1278 | 1018 | 1321 |
| | | | | (279) | (42) | (91) | (227) |
| DEL 6 | Barley | 30 | 2893 | 2379 | 2236 | 2069 | 2748 |
| | | | | (974) | (102) | (611) | (462) |
| DEL 7 | Barley | 49 | 2559 | 2379 | 2236 | 2069 | 2748 |
| | | | | (974) | (102) | (611) | (462) |
| DVG 1 | Barley | 32 | 2530 | 2156 | | 1967 | |
| | | | | (61) | (14) | (54) | (21) |
| FSH 1 | Barley | 36 | 2546 | 2346 | | 2406 | |
| | | | | (49) | (14) | (52) | (11) |
| LLK 1 | Barley | 51 | 2477 | 2378 | 2176 | 1998 | |
| | | | | (34) | (38) | (45) | (27) |
| LLK 1 | Oats | 39 | 2027 | | 2158 | | |
| | | | | (17) | (33) | (25) | (25) |
| RKAD1 | Barley | 145 | 2452 | 2438 | 2564 | 2155 | 3002 |
| | | | | (304) | (40) | (223) | (121) |
| ADHP1 | Barley | 30 | 2296 | | | | |
| | | | | (29) | (2) | (23) | (8) |
| RKAD5 | Barley | 98 | 2400 | 2438 | 2564 | 2155 | 3002 |
| | | | | (304) | (40) | (223) | (121) |
| DERK1 | Wheat | 52 | 2374 | 2209 | | 2014 | 2505 |
| | | | | (61) | (7) | (36) | (32) |
| DERK1 | Barley | 63 | 2268 | 2442 | | 2138 | 2581 |
| | | | | (59) | (15) | (42) | (22) |
| MDAD1 | Barley | 49 | 2230 | 2265 | | | |
| | | | | (43) | (6) | (27) | (22) |

Note: Where there are less than 30 records, no values were given (numbers in brackets are number of records used for computing average).

**Table 12.** Non-agricultural (pedotechnical) interpretations of the Calgary urban perimeter survey area soil units.

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| ADHP 1 | c | fair-poor | very poor-poor | fair-good | none | moderate | Thickness of Ah, SiCL-SL texture, shrink-swell, slope, moderate permeability |
| ADHP 1 | d | fair-poor | very poor-poor | fair-good | none | moderate | Thickness of Ah, SiCL-SL texture, shrink-swell, slope, moderate permeability |
| ADHP 2 | d | poor | poor | fair | none | slight-severe | Thickness of Ah, scattered sandy ridges, shrink-swell, wetspots, occasional flooding in low spots |
| ADHP 3 | d | fair-poor | poor-fair | fair-good | none | moderate | Thickness of Ah, scattered buried sand cores, shrink-swell, rapid permeability |
| ADHP 3 | e | fair-poor | poor-fair | fair-good | none | severe | Thickness of Ah, scattered buried sand cores, shrink-swell, rapid permeability |
| ADHP 3 | f | poor | poor-fair | fair | none | severe | Thickness of Ah, scattered buried sand cores, shrink-swell, slope, rapid permeability |
| ATL 1 | c | fair | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, unified soil group, slope, moderate permeability |
| ATL 1 | d | fair-good | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, unified soil group, slope, moderate permeability |
| ATL 1 | e | fair-good | very poor | fair | none | severe | Thickness of Ah, SiCL texture, shrink-swell, unified soil group, slope, moderate permeability |
| ATL 2 | c | fair-poor | very poor | fair-poor | none | moderate | Thickness of Ah, wetspots, SiCL texture, shrink-swell, unified soil group, slope, moderate permeability, occasional flooding in low spots |
| ATL 2 | d | fair-poor | very poor | fair-poor | none | moderate | Thickness of Ah, wetspots, SiCL texture, shrink-swell, unified soil group, slope, moderate permeability, occasional flooding in low spots |
| ATL 3 | d | fair-poor | very poor | fair | none | moderate-severe | Thickness of Ah, SiCL texture, shrink-swell, depth to bedrock |
| ATL 3 | e | fair-poor | very poor | fair | none | severe | Thickness of Ah, SiCL texture, shrink-swell, unified soil group, slope |
| ATL 3 | f | poor | very poor | fair | none | severe | Thickness of Ah, SiCL texture, shrink-swell, unified soil group, slope |
| ATL 5 | c | fair-poor | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, unified soil group, slope, moderate permeability |
| ATL 5 | de | fair-poor | very poor | fair | none | severe | Thickness of Ah, wetspots, SiCL texture, unified soil group, slope, shrink-swell |
| BED 1 | c | poor | very poor | fair-poor | none | slight-moderate | Thickness of Ah, salinity, SiCL texture, shrink-swell, seasonally high water table |
| BED 2 | c | poor | very poor | fair-poor | none | slight-moderate | Thickness of Ah, salinity, SiCL texture, shrink-swell, seasonally high water table |
| BED 3 | c | poor | very poor | poor | infrequent | moderate | Thickness of Ah, salinity, SiCL texture, shrink-swell, seasonally high water table, wetness |
| BOV 1 | b | poor | sand:poor gravel: good-fair | good | infrequent | severe | Thickness of Ah, stoniness, rapid permeability, high coarse fragment content |
| BOV 1 | c | poor | sand:poor gravel: good | good | infrequent | severe | Thickness of Ah, stoniness, rapid permeability, high coarse fragment content |
| BOV 2 | f | poor | fair-poor | fair | infrequent | severe | Thickness of Ah, stoniness, slope, thin gravel veneer, rapid permeability |
| BPW 1 | d | poor | very poor | fair | none | severe | Thickness of Ah, SiCL texture, potential frost heave, slope |
| BRG 1 | b | very poor | very poor | good-fair | occasional | severe | No Ah, stoniness, SiCL texture, rapid permeability, seasonally high water table |
| BZC 1 | a | very poor | very poor | very poor | frequent | severe | Flooding hazard, salinity, seasonally high water table, CL texture, wetness |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| BZC 2 | bd | very poor | very poor | very poor | occasional | severe | Flooding hazard, salinity, seasonally high water table, CL texture, wetness |
| BZC 3 | b | poor | very poor | very poor | frequent | severe | Flooding hazard, salinity, seasonally high water table, CL texture, wetness |
| BZC 4 | bc | poor | very poor | very poor | frequent | severe | Flooding hazard, salinity, seasonally high water table, CL texture, wetness |
| CON 1 | d | very poor | sand:fair gravel: poor | good | none | severe | No Ah, rapid permeability, unified soil group, sandy, depth to sand and gravel |
| DEL 1 | b | fair-good | very poor | fair | none | slight-moderate | Thickness of Ah, CL-L texture, shrink-swell, potential frost action, moderate permeability |
| DEL 1 | c | fair-good | very poor | fair | none | slight-moderate | Thickness of Ah, CL-L texture, shrink-swell, potential frost heave, moderate permeability |
| DEL 1 | d | fair-good | very poor | fair | none | slight-moderate | Thickness of Ah, CL-L texture, shrink-swell, potential frost heave, moderate permeability |
| DEL 2 | c | fair | very poor | fair | occasional in lows, | moderate | Thickness of Ah, wetspots, CL-L texture, shrink-swell, potential frost action, moderate permeability |
| DEL 3 | c | fair-poor | very poor | poor-fair | frequent in lows | moderate-severe | Thickness of Ah, wetspots, salinity, CL-L texture, shrink-swell, potential frost heave, moderate permeability |
| DEL 4 | c | fair | very poor | fair-poor | none | slight-moderate | Thickness of Ah, CL-L texture, shrink-swell, potential frost action, shrink-swell, moderate permeability |
| DEL 5 | c | fair-poor | very poor | fair-poor | frequent in lows | moderate-severe | Thickness of Ah, salinity, CL-L texture, potential frost action, moderate permeability, shrink-swell |
| DEL 6 | b | fair-good | very poor | fair | frequent in lows | moderate | Thickness of Ah, wetspots, CL-L texture potential frost action, moderate permeability, seasonally high water table |
| DEL 6 | c | fair-good | very poor | fair | occasional in lows | moderate | Thickness of Ah, wet spots, CL-L texture, potential frost action, moderate permeability, seasonally high water table |
| DEL 7 | c | fair | very poor | fair | none | moderate | Thickness of Ah, CL-L texture, shrink-swell, potential frost action, moderate permeability, unified soil group |
| DEL 7 | d | fair | very poor | fair | none | severe | Thickness of Ah, CL-L texture, shrink-swell, potential frost heave, moderate permeability, unified soil group |
| DEL 8 | db | fair-poor | very poor | fair-poor | none | moderate | Thickness of Ah, flooding hazard, CL-L texture, shrink-swell, potential frost heave, moderate permeability |
| DEL 9 | d | fair-good | sand:fair-poor gravel: poor | fair-good | none | severe | Thickness of Ah, buried sand suspected, shrink-swell, moderate permeability, potential frost heave, unified soil group, slope |
| DEL 9 | e | fair | sand:fair-poor gravel: poor | fair-good | none | severe | Thickness of Ah, shrink-swell, potential frost action, slope, unified soil group, moderate permeability |
| DERK 1 | b | fair-good | very poor | fair | none | slight-moderate | Thickness of Ah, unified soil group, shrink-swell, potential frost action, moderate permeability, slope |
| DERK 1 | c | fair-good | very poor | fair | none | moderate | Thickness of Ah, unified soil group, shrink-swell, potential frost action, moderate permeability, slope |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| DERK 1 | d | fair-good | very poor | fair | none | moderate | Thickness of Ah, unified soil group, shrink-swell, potential frost action, moderate permeability, slope |
| DERK 2 | b | fair | very poor | fair | occasional in lows | slight-moderate | Thickness of Ah, wet spots, unified soil group, shrink-swell, potential frost heave, moderate permeability |
| DERK 2 | c | fair | very poor | fair | occasional in lows | slight-moderate | Thickness of Ah, wet spots, unified soil group, shrink-swell, moderate permeability |
| DVFS 1 | d | fair-poor | very poor | poor-fair | none | moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| DVFS 1 | e | fair-poor | very poor | poor-fair | none | severe | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| DVFS 2 | e | poor | very poor | poor | occasional in lows | severe | Thickness of Ah, wetspots, C-SiCL texture, unified soil group, shrink-swell, moderate permeability |
| DVG 1 | c | fair | very poor | poor-fair | none | slight-moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, slope |
| DVG 1 | d | fair | very poor | poor-fair | none | moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, slope |
| DVG 1 | e | fair | very poor | poor-fair | none | severe | Thickness of Ah, SiC texture, unified soil group, shrink-swell, slope |
| DVG 2 | c | fair-poor | very poor | poor | occasional in lows | slight-moderate | Thickness of Ah, wet spots, SiCL texture, unified soil group, shrink-swell, slope |
| DVG 2 | d | fair-poor | very poor | poor | occasional in lows | moderate | Thickness of Ah, wet spots, SiCL texture, unified soil group, shrink-swell, slope |
| DVG 3 | e | fair | very poor | poor-fair | none | severe | Thickness of Ah, slope, SiCL texture, unified soil group, shrink-swell |
| DVG 3 | fg | poor-very poor | very poor | poor | none | severe | Thickness of Ah, slope, SiCL texture, unified soil group, shrink-swell |
| DVG 4 | c | fair-good | very poor | poor | occasional in lows | moderate | Thickness of Ah, wet spots, SiCL texture, unified soil group, shrink-swell, flooding hazard, slope |
| DVG 4 | d | fair-poor | very poor | poor | occasional in lows | moderate | Thickness of Ah, wet spots, SiCL texture, unified soil group, shrink-swell, flooding hazard, slope |
| DWHP 1 | b | poor | sand: poor-very poor gravel: poor-very poor | very poor | frequent | severe | Thickness of Ah, flooding hazard, seasonally high water table, wetness, rapid permeability |
| DWHP 1 | c | poor | sand: poor-very poor gravel: poor-very-poor | very poor | occasional | severe | Thickness of Ah, flooding hazard, seasonally high water table, wetness, rapid permeability |
| DWT 1 | ab | poor | very poor | very poor | frequent | severe | Flooding hazard, wetness, SiL-CL texture, unified soil group, seasonally high water table |
| DWT 2 | a | poor | very poor | very poor | frequent | severe | Flooding hazard, wetness, SiL-CL texture, unified soil group, seasonally high water table |
| DWT 3 | a | very poor | very poor | very poor | frequent | severe | Permanently wet, flooding hazard, SiL-CL texture, unified soil group, seasonally high water table |
| EBAD 1 | c | poor-fair | very poor-poor | fair | none | slight-moderate | Thickness of Ah, SiCL-LS texture, depth to sand and gravel, moderate shrink-swell, potential frost heave, moderate permeability, slope |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| EBAD 2 | d | poor-fair | very poor-poor | fair | occasional in lows | slight-moderate | Thickness of Ah, SiCL-LS texture, depth to sand and gravel, moderate shrink-swell, potential frost heave, moderate permeability, slope |
| ELRS 1 | c | poor-very poor | very poor | poor | none | slight-moderate | Thickness of Ah, C texture, unified soil group, shrink-swell, potential frost heave, slope |
| ELRS 1 | d | poor-very poor | very poor | poor | none | moderate | Thickness of Ah, C texture, unified soil group, shrink-swell, potential frost heave, slope |
| ELRS 1 | e | poor-very poor | very poor | poor | none | severe | Thickness of Ah, C texture, unified soil group, shrink-swell, potential frost heave, slope |
| ELRS 2 | c | poor-very poor | very poor | poor | none | slight-moderate | Thickness of Ah, C texture, unified soil group, shrink-swell, potential frost heave, depth to sand and gravel, slope |
| ELRS 3 | e | poor-very poor | very poor | poor | none | severe | Thickness of Ah, C texture, unified soil group, shrink-swell, potential frost heave, slope |
| ELRS 3 | fg | poor-very poor | very poor | poor | none | severe | Thickness of Ah, C texture, unified soil group, shrink-swell, potential frost heave, slope |
| ELRS 4 | cd | very poor | very poor | moderate-severe | none | slight-moderate | Thickness of Ah, C texture, wetspots, unified soil group, depth to sand and gravel,moderate permeability, slope |
| FSH 1 | b | fair-poor | very poor | poor | none | slight | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave |
| FSH 1 | c | fair-poor | very poor | poor | none | slight-moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| FSH 1 | d | fair-poor | very poor | poor | none | moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| FSH 2 | b | poor | very poor | poor | occasional in lows | slight | Thickness of Ah, wetspots, SiC texture, unified soil group, shrink-swell, potential frost heave |
| FSH 2 | c | poor | very poor | poor | occasional in lows | slight moderate | Thickness of Ah, wet spots, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| FSH 2 | d | poor | very poor | poor | occasional in lows | moderate | Thickness of Ah, wet spots, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| FSH 3 | c | fair-poor | very poor | poor-fair | none | slight-moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| FSH 3 | d | fair-poor | very poor | poor-fair | none | moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| FSH 4 | cd | poor | very poor | poor-fair | occasional in lows | moderate | Thickness of Ah, wetspots, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| FSH 5 | d | fair-poor | very poor | poor-fair | none | moderate | Thickness of Ah, SiC texture, unified soil group, shrink-swell, potential frost heave, slope |
| HIBO 1 | b | fair-poor | sand:poor gravel: good | good | infrequent | severe | Thickness of Ah, loose consistence, depth to sand and gravel, rapid permeability |
| HIBO 1 | c | fair-good | sand:poor gravel: good | good | infrequent | severe | Thickness of Ah, loose consistence, depth to sand and gravel, rapid permeability |
| HIW 1 | b | fair-good | sand:poor gravel: fair-good | good | infrequent | moderate-severe | Loose consistence, thickness of Ah, unified soil group, depth to sand and gravel, rapid permeability |
| HIW 1 | c | fair-good | sand:poor gravel: fair-good | good | infrequent | moderate-severe | Loose consistence, thickness of Ah, unified soil group, depth to sand and gravel, rapid permeability |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| HPAD 1 | c | poor-fair | sand:poor gravel: very poor | good-fair | none | moderate-severe | Thickness of Ah, loose consistence, unified soil group, moderate shrink-swell, potential frost heave, moderate-rapid permeability |
| HPAD 1 | d | poor-fair | sand:poor gravel: very poor | good-fair | none | moderate-severe | Thickness of Ah, loose consistence, unified soil group, moderate shrink-swell, potential frost heave, moderate-rapid permeability |
| HPAD 3 | d | poor-fair | sand:poor gravel: very poor | good-fair | none | moderate-severe | Thickness of Ah, loose consistence, unified soil group, moderate shrink-swell, potential frost heave, moderate-rapid permeability |
| HPAD 3 | e | poor-fair | sand:poor gravel: very poor | good-fair | none | severe | Thickness of Ah, loose consistence, unified soil group, moderate shrink-swell, potential frost heave, slope, moderate-rapid permeability |
| HPAD 4 | e | poor-fair | sand:poor gravel: very poor | good-fair | none | severe | Thickness of Ah, slope, loose consistence moderate shrink-swell, potential frost heave, moderate-rapid permeability |
| HPV 1 | cb | poor-fair | sand:poor gravel: very poor | good | none | severe | Thickness of Ah, loose consistence, unified soil group, rapid permeability |
| HPV 2 | d | poor-fair | sand:poor gravel: very poor | good | none | severe | Thickness of Ah, unified soil group, rapid permeability, presence of carbonates |
| HPV 2 | e | poor | sand:poor gravel: very poor | good | none | severe | Thickness of Ah, unified soil group, rapid permeability, slope, presence of carbonates |
| HPV 3 | d | poor-fair | sand: poor-fair gravel: very poor | good | none | severe | Thickness of Ah, unified soil group, rapid permeability, presence of carbonates |
| HPSC 1 | d | poor | sand: poor-fair gravel: poor-fair | good | none | severe | Thickness of Ah, stoniness, unified soil group, rapid permeability |
| IND 1 | ab | poor | very poor | very poor | frequent | severe | Wetness, CL texture, unified soil group, shrink-swell, potential frost heave, flooding hazard, seasonally high water table |
| IND 2 | b | poor | very poor | poor-very poor | frequent | severe | Wetness, CL texture, unified soil group, shrink-swell, potential frost action, flooding hazard |
| IND 2 | c | poor-fair | very poor | poor-very poor | frequent | severe | Wetness, CL texture, unified soil group, shrink-swell, potential frost heave, flooding hazard, seasonally high water table |
| LLK 1 | b | good-fair | very poor | fair | none | slight-moderate | Thickness of Ah, SiCL texture, shrink-swell, potential frost heave, unified soil group |
| LLK 1 | c | good-fair | very poor | fair | none | slight-moderate | Thickness of Ah, SiCL texture, shrink-swell, potential frost heave, unified soil group |
| LLK 1 | d | good-fair | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, potential frost heave, unified soil group |
| LLK 2 | b | fair | very poor | fair-poor | frequent in lows | slight-moderate | Thickness of Ah, SiCL texture, shrink-swell, wet spots, salinity, flooding hazard, seasonally high water table |
| LLK 3 | d | good-fair | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, unified soil group, shrink-swell, potential frost heave, slope |
| LLK 3 | e | fair | very poor | fair | none | severe | Thickness of Ah, SiCL texture, unified soil group, shrink-swell, potential frost heave, slope |
| LLK 3 | f | poor | very poor | poor-fair | none | severe | Thickness of Ah, SiCL texture, unified soil group, shrink-swell, potential frost heave, slope |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| LLK 4 | c | good-fair | sand:very very poor gravel: fair-good | fair-good | none | moderate | Thickness of Ah, SiCL texture, unified soil group, depth to sand and gravel, shrink-swell, potential frost heave, slope |
| LTC 1 | e | poor | very poor | fair-poor | none | severe | Ahe horizon, slope, unified soil group, soil texture, depth to bedrock, shrink-swell, potential frost heave |
| LTC 1 | f | poor | very poor | fair-poor | none | severe | Ahe horizon, slope, unified soil group, soil texture, depth to bedrock, potential frost heave, shrink-swell |
| LTC 1 | g | very poor | very poor | poor | none | severe | Ahe horizon, slope, unified soil group, soil texture, depth to bedrock, shrink-swell, potential frost heave |
| LTC 2 | c | poor | very poor | fair-poor | none | slight- | Ahe horizon, unified soil group, soil texture, moderate shrink-swell, potential frost heave, slope |
| LTC 2 | d | poor | very poor | fair-poor | none | moderate | Ahe horizon, unified soil group, soil texture, shrink-swell, potential frost heave, slope |
| MDAD 1 | c | good-fair | sand: poor-fair gravel: very poor | good-fair | none | moderate-severe | Thickness of Ah, SiCL texture, unified soil group moderate shrink-swell, potential frost heave, moderate-rapid permeability |
| MDAD 1 | d | good-fair | sand: poor-fair gravel: very poor | good-fair | none | moderate-severe | Thickness of Ah, SiCL texture, unified soil group moderate shrink-swell, potential frost heave, moderate-rapid permeability |
| MDP 1 | c | good | sand: poor-fair gravel: very poor | good | none | severe | Unified soil group, rapid permeability |
| MDP 1 | d | good | sand: | good | none | severe | Unified soil group, rapid permeability |
| MDP 2 | d | good-fair | sand:poor gravel: very poor | good-fair | frequent | severe | Wet spots, unified soil group, rapid permeability, slope |
| MD-L 1 | c | fair | sand: poor- very poor gravel: very poor | fair-poor | none | Severe | Thickness of Ah, slope, stoniness, depth to bedrock, rapid permeability |
| MSB 1 | f | very poor | very poor | poor | none | severe | Thickness of Ah, slope, stoniness, unified soil group, ST, depth to bedrock, shrink-swell, potential frost heave |
| MSB 1 | gh | very poor | very poor | poor-very poor | none | severe | Thickness of Ah, Slope, stoniness, unified soil group, depth to bedrock, shrink-swell, potential frost heave |
| NSK 1 | c | poor | very poor | fair-poor | infrequent | moderate | Thickness of Ah, salinity, unified soil group, soil texture, potential frost heave, depth to bedrock, moderate permeability |
| NSK 2 | bd | poor-very poor | very poor | poor | occasional frequent | moderate-severe | Thickness of Ah, wet spots, salinity, flooding hazard, unified soil group, moderate permeability, depth to bedrock |
| NSK 3 | b | poor-very poor | very poor | poor | infrequent | moderate | Thickness of Ah, wet spots, flooding hazard, salinity, unified soil group, depth to bedrock, moderate permeability, potential frost heave |
| POT 1 | ab | poor-very poor | very poor | very poor | frequent | severe | Wetness, thickness of Ah, flooding hazard, unified soil group, potential frost heave, depth to water table |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| POT 2 | ab | very poor | very poor | very poor | frequent | severe | Wetness, thickness of Ah, flooding hazard, unified soil group, depth to water table, potential frost heave, soil texture |
| POT 2 | c | poor-very poor | very poor | very poor | frequent | severe | Wetness, thickness of Ah, flooding hazard, unified soil group, soil texture, potential frost heave, depth to water table |
| POT 3 | bd | poor | very poor | very poor | frequent | severe | Wetness, thickness of Ah, flooding hazard, unified soil group, soil texture, potential frost heave, depth to water table |
| RB 1 | e | poor | very poor | fair-poor | none | severe | Slope, thickness of Ah, unified soil group, soil texture, shrink-swell, AASHO |
| RB 1 | f | poor | very poor | fair-poor | none | severe | Slope, thickness of Ah, unified soil group, soil texture, AASHO, shrink-swell |
| RB 1 | gh | very poor | very poor | poor-very poor | none | severe | Slope, thickness of Ah, unified soil group, soil texture, shrink-swell, AASHO |
| RB 2 | f | very poor | very poor | poor | none | severe | Slope, stoniness, unified soil group, soil texture, AASHO, shrink-swell, depth to bedrock |
| RB 2 | gh | very poor | very poor | poor-very poor | none | severe | Slope, stoniness, unified soil group, soil texture, AASHO, shrink-swell, depth to bedrock |
| RB 4 | de | poor | very poor | poor | occasional in lows | severe | Slope, thickness of Ah, unified soil group, soil texture, wetness, AASHO, shrink-swell |
| RB 4 | f | poor | very poor | poor | occasional in lows | severe | Slope, thickness of Ah, unified soil group, wetness, AASHO, shrink-swell, soil texture |
| RB 4 | gh | very poor | very poor | very poor | occasional in lows | severe | Slope, thickness of Ah, unified soil group, flooding hazard, wetness, AASHO, shrink-swell |
| RB 5 | f | very poor | very poor | poor-very poor | none | severe | Slope, thickness of Ah, erosion, unified soil group, stoniness, AASHO, shrink-swell |
| RB 5 | gh | very poor | very poor | poor-very poor | none | severe | Slope, thickness of Ah, erosion, unified soil group, soil texture, AASHO, shrink-swell |
| RKAD 1 | c | fair | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, frost heave, slope, moderate permeability |
| RKAD 1 | d | fair | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, frost heave, slope, moderate permeability |
| RKAD 2 | c | fair-poor | very poor | fair-poor | none | moderate | Thickness of Ah, wet spots, SiCL texture, shrink-swell, frost heave, slope, moderate permeability, occasional flooding in low spots |
| RKAD 2 | d | fair-poor | very poor | fair-poor | none | moderate | Thickness of Ah, wet spots, SiCL texture, shrink-swell, frost heave, slope, moderate permeability, occasional flooding in low spots |
| RKAD 3 | d | fair-poor | very poor | fair | none | moderate-severe | Thickness of Ah, SiCL texture, shrink-swell, depth to bedrock, slope |
| RKAD 3 | e | fair-poor | very poor | fair | none | severe | Thickness of Ah, SiCL texture, shrink-swell, unified soil group, slope, depth to bedrock |
| RKAD 4 | c | fair-poor | very poor | fair-poor | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, wet spots, slope, moderate permeability |
| RKAD 5 | c | fair-poor | very poor | fair | none | moderate | Thickness of Ah, SiCL texture, shrink-swell, frost heave, slope moderate permeability |
| RKAD 5 | d | fair-poor | very poor | fair | none | moderate | Thickness of Ah, wet spots, SiCL texture, frost heave, slope, shrink-swell |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| SCO 1 | c | poor | sand: poor gravel: good-fair | good-fair | none | severe | Thickness of Ah, flooding hazard, stoniness, unified soil group, rapid permeability |
| SCO 1 | d | poor | sand: poor gravel: good-fair | good-fair | none | severe | Thickness of Ah, flooding hazard, stoniness, unified soil group, rapid permeability |
| SCO 2 | dc | poor | sand: poor-fair gravel: good-fair | good-fair | none | severe | Thickness of Ah, flooding hazard, stoniness, unified soil group, rapid permeability, mixed sand and gravel |
| SCO 2 | e | poor | sand: poor-fair gravel: good-fair | good-fair | none | severe | Thickness of Ah, flooding hazard, stoniness, slope, unified soil group, rapid permeability, mixed sand and gravel |
| SCO 3 | bc | very poor | sand: very poor gravel: poor-very poor | fair | occasional | severe | Thickness of Ah, flooding hazard, stoniness unified soil group, rapid permeability, patchy gravel over bedrock, slope |
| SCO 3 | de | very poor | sand: very poor gravel: poor-very poor | fair | occasional | severe | Thickness of Ah, flooding hazard, stoniness, unified soil group, rapid permeability, patchy gravel over bedrock, slope |
| SPR 1 | d | very poor | very poor | fair | none | moderate | Thickness of Ah, stoniness, unified soil group, soil texture, potential frost heave, shrink-swell, slope, coarse fragments |
| SPR 1 | e | very poor | very poor | fair | none | severe | Thickness of Ah, soil texture, unified soil group, stoniness, potential frost heave, shrink-swell, depth to bedrock, coarse fragments, slope |
| SPR 1 | f | very poor | very poor | fair-poor | none | severe | Thickness of Ah, stoniness, unified soil group, stoniness, potential frost heave, shrink-swell, slope, depth to bedrock, coarse fragments, soil texture |
| SPR 1 | gh | very poor | very poor | poor-very poor | none | severe | Thickness of Ah, stoniness, unified soil group, stoniness, potential frost heave, slope, shrink-swell, depth to bedrock, coarse fragments, soil texture |
| SPR 2 | d | poor | very poor | fair | none | moderate | Thickness of Ah, stoniness, unified soil group, stoniness, potential frost heave, slope, shrink-swell, depth to bedrock, coarse fragments, soil texture |
| SPR 2 | e | poor | very poor | fair | none | severe | Thickness of Ah, stoniness, unified soil group, stoniness, potential frost heave, slope, shrink-swell, depth to bedrock, coarse fragments, soil texture |
| SPR 2 | fg | very poor - poor | very poor | very poor - poor | none | severe | Thickness of Ah, slope, unified soil group, soil texture, shrink-swell, potential frost heave, depth to bedrock |
| SPY 1 | d | poor | very poor | fair | occasional in lows | moderate | Thickness of Ah, unified soil group, stoniness, slope, shrink-swell, flooding hazard, coarse fragments, soil texture |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitability as a source of: Topsoil | Sand or gravel | Roadfill | Comments regarding: Flooding hazard | Reservoir sites | Features affecting use of interpretation of the unit |
|---|---|---|---|---|---|---|---|
| SPY 1 | e | poor | very poor | fair | occasional in lows | severe | Thickness of Ah, unified soil group, stoniness, flooding hazard, shrink-swell, coarse fragments, slope, soil texture |
| SPY 1 | fg | poor | very poor | fair-poor | occasional in lows | severe | Thickness of Ah, unified soil group, flooding hazard, shrink-swell, stoniness, coarse fragments, slope, soil texture |
| SPY 2 | d | poor - | very poor | fair-poor | frequent in lows | moderate | Thickness of Ah, wet spots, unified soil group, flooding hazard, shrink-swell, stoniness, coarse fragments, soil texture |
| SPY 2 | e | poor - very poor | very poor | fair-poor | frequent in lows | severe | Thickness of Ah, wet spots, unified soil group, flooding hazard, shrink-swell, stoniness, coarse fragments, slope, soil texture |
| SPY 2 | f | very poor | very poor | fair-poor | frequent in lows | severe | Thickness of Ah, wet spots, unified soil group, flooding hazard, shrink-swell, stoniness, coarse fragments, slope, soil texture |
| SRC 1 | b | fair-good | very poor - fair | good-fair | infrequent | moderate-severe | Thickness of Ah, unified soil group, scattered gravel patches, potential frost heave, flooding hazard, rapid permeability |
| SRC 2 | bd | fair-poor | very poor - poor | poor | frequent | severe | Flooding hazard, wet spots, unified soil group, potential frost action, seasonally high water table, rapid permeability |
| SRC 3 | b | fair-good | fair | fair | infrequent | severe | Thickness of Ah, flooding hazard, stoniness, depth to sand and gravel, seasonally high water table, potential frost heave, wet spots, rapid permeability |
| SRC 4 | bd | fair-poor | fair-poor | poor | frequent | severe | Flooding hazard, wet spots, thickness of Ah, seasonally high water table, potential frost heave, rapid permeability |
| SUD 1 | b | poor | good-fair | good | infrequent | severe | Thickness of Ah, flooding hazard, stoniness, seasonally high water table, rapid permeability, unified soil group |
| TBR 1 | bd | poor | poor-fair | fair | infrequent occasional | severe | Flooding hazard, thickness of Ah, loose consistence, scattered gravel patches, potential frost heave, seasonally high water table, rapid permeability |
| TM 1 | a | very poor | very poor | very poor | permanent wet | severe | Organic soils, permanently wet |
| TWS 1 | bc | good-fair | very poor | fair-good | infrequent | moderate | Thickness of Ah, surface texture, unified soil group, stoniness, potential frost heave, shrink-swell, moderate permeability, soil texture |
| TWS 1 | d | fair | very poor | fair-good | none | moderate | Thickness of Ah, surface texture, slope, unified soil group, stoniness, potential frost heave, shrink-swell, moderate permeability, soil texture |
| TWS 2 | bd | fair-poor | very poor | poor | frequent | severe | Flooding hazard, wet spots, thickness of Ah, unified soil group, stoniness, potential frost heave, shrink-swell, seasonally high water table, moderate permeability, soil texture |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| ADHP 1 | c | slight-moderate | slight-moderate | slight | slight-moderate | slight-moderate | Shrink-swell, potential frost action, SiCL-SL texture |
| ADHP 1 | d | slight-moderate | slight-moderate | slight | slight-moderate | slight-moderate | Shrink-swell, potential frost heave, SiCL-SL texture |
| ADHP 2 | d | slight-moderate | slight-moderate | slight | slight | slight-moderate | Shrink-swell, potential frost heave, wet spots, SiCL texture |
| ADHP 3 | d | slight-moderate | slight-moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, SiCL-SL texture, moderate permeability |
| ADHP 3 | e | moderate | moderate | moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, slope, SiCL-SL texture, moderate permeability |
| ADHP 3 | f | severe | severe | severe | severe | moderate | Slope, shrink-swell, potential frost heave, united soil group, moderate permeability |
| ATL 1 | c | moderate | moderate | slight | moderate | slight-moderate | Moderate shrink-swell, potential frost heave, moderate permeability, L-SiCL texture |
| ATL 1 | d | moderate | moderate | slight | moderate | slight-moderate | Moderate shrink-swell, potential frost heave, moderate permeability, L-SiCL texture |
| ATL 1 | e | moderate | moderate | moderate | moderate | slight-moderate | Moderate shrink-swell, potential frost heave, slope, moderate permeability, L-SiCL texture |
| ATL 2 | c | moderate | moderate | slight-moderate | moderate | moderate | Moderate shrink-swell, potential frost heave, wet spots, seasonally high water table, L-SiCL texture |
| ATL 2 | d | moderate | moderate | slight-moderate | moderate | moderate | Moderate shrink-swell, potential frost heave, wet spots, seasonally high water table, L-SiCL texture |
| ATL 3 | d | moderate | moderate | slight-moderate | moderate-severe | moderate-severe | Moderate shrink-swell, potential frost heave, depth to bedrock, moderate permeability, L-SiCL texture |
| ATL 3 | e | moderate | moderate | moderate | moderate-severe | moderate-severe | Moderate shrink-swell, potential frost heave, depth to bedrock, moderate permeability, L-SiCL texture |
| ATL 3 | f | severe | severe | severe | severe | moderate-severe | Slope, moderate shrink-swell, potential frost action, depth to bedrock, moderate permeability, L-SiCL texture |
| ATL 5 | c | moderate | moderate | slight | moderate | slight-moderate | Wet spots, moderate shrink-swell, potential frost heave, moderate permeability, L-SiCL texture |
| ATL 5 | de | moderate | moderate | moderate | moderate | slight-moderate | Wet spots, moderate shrink-swell, potential frost heave, moderate permeability, depth to bedrock, L-SiCL texture |
| BED 1 | c | moderate-severe | moderate | moderate | severe | moderate-severe | Moderate shrink-swell, drainage class, salinity, potential frost action, sulfate attack, seasonal water table |
| BED 2 | c | moderate-severe | moderate | moderate | moderate-severe | moderate | Moderate shrink-swell, drainage class, salinity, potential frost action, sulfate attack, seasonal water table |
| BED 3 | c | moderate-severe | severe | severe | severe | severe | Moderate shrink-swell, drainage class, salinity, potential frost action, sulfate attack, seasonal water table |
| BOV 1 | b | slight | slight | severe | severe | severe | Gravelly soils, groundwater contamination hazard, depth to sand and gravel |
| BOV 1 | c | slight | slight | severe | severe | severe | Gravelly soils, groundwater contamination hazard, depth to sand and gravel |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| BOV 2 | f | severe | severe | severe | severe | severe | Slope, gravelly soils, stoniness |
| BPW 1 | d | moderate-severe | moderate | slight | moderate | moderate | Potential frost heave, shrink-swell, moderately slow permeability, SiCL texture |
| BRG 1 | b | moderate | severe | severe | severe | severe | Seasonally high water table, flooding hazard, gravelly soil, groundwater contamination hazard |
| BZC 1 | a | very poor | vere severe | severe | very severe | very severe | Permanently wet, sulfate attack, flooding hazard, seasonally high water table, SiC texture |
| BZC 2 | bd | very poor | very severe | severe | very severe | very severe | Permanently wet, sulfate attack, flooding hazard, seasonally high water table, SiC texture |
| BZC 3 | b | very poor | very severe | severe | very severe | very severe | Permanently wet, sulfate attack, flooding hazard, seasonally high water table, SiC texture |
| BZC 4 | bc | very poor | very severe | severe | very severe | very severe | Permanently wet, sulfate attack, flooding hazard, seasonally high water table, SiC texture |
| CON 1 | d | slight | slight-moderate | severe | slight | severe | Potential frost heave, shrink-swell, texture, rapid permeability |
| DEL 1 | b | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, soil texture |
| DEL 1 | c | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, soil texture |
| DEL 1 | d | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, soil texture |
| DEL 2 | c | moderate-severe | moderate-severe | slight-moderate | moderate | slight-moderate | Wet spots, shrink-swell, potential frost heave, soil texture, moderate permeability, seasonally high water table |
| DEL 3 | c | moderate-severe | moderate-severe | moderate | moderate | moderate | Wet spots, shrink-swell, potential frost heave, soil texture, moderate permeability, flooding hazard, seasonally high water table |
| DEL 4 | c | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, soil texture, moderate permeability |
| DEL 5 | c | moderate-severe | moderate-severe | moderate | severe | moderate-severe | Shrink-swell, potential frost heave, wet spots, salinity, soil texture, moderate permeability, flooding hazard, depth to water table |
| DEL 6 | b | moderate-severe | moderate-severe | moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, wet spots, soil texture, moderate permeability |
| DEL 6 | c | moderate-severe | moderate-severe | moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, wet spots, soil texture, moderate permeability |
| DEL 7 | c | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, soil texture |
| DEL 7 | db | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, soil texture |
| DEL 8 | db | moderate | moderate | moderate-severe | severe | moderate-severe | Shrink-swell, potential frost heave, flooding hazard, seasonally high water table, slope, soil texture |
| DEL 9 | d | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, depth to sand and gravel, soil texture |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| DEL 9 | e | moderate | moderate | moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, slope, moderate permeability, depth to sand and gravel, soil texture |
| DERK 1 | b | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, soil texture |
| DERK 1 | c | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, moderate permeability, soil texture |
| DERK 1 | d | moderate | moderate | slight-moderate | moderate | slight-moderate | Potential frost heave, shrink-swell, soil texture, moderate permeability, AASHO group index |
| DERK 2 | b | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, wet spots, moderate permeability, AASHO group index, soil texture |
| DERK 2 | c | moderate | moderate | slight-moderate | moderate | slight-moderate | Shrink-swell, potential frost heave, wet spots, severe flooding in depressions, moderate permeability, soil texture |
| DVFS 1 | d | moderate-severe | moderate-severe | moderate-severe | moderate-severe | moderate-severe | High shrink-swell, wetness, potential frost heave, C-SiC texture, slow permeability |
| DVFS 1 | e | moderate-severe | moderate-severe | moderate-severe | moderate-severe | moderate-severe | High shrink-swell, wetness, potential frost heave, C-SiC texture, slow permeability |
| DVFS 2 | e | moderate-severe | moderate-severe | moderate-severe | moderate-severe | moderate-severe | High shrink-swell, wetness, potential frost heave, C-SiC texture, slow permeability |
| DVG 1 | c | moderate-severe | moderate | moderate | moderate | moderate-severe | High shrink-swell, potential frost heave, CL-SiC texture, moderate permeability, unified soil group |
| DVG 1 | d | moderate-severe | moderate | moderate | moderate | moderate-severe | High shrink-swell, potential frost heave, CL-SiC texture, moderate permeability, unified soil group |
| DVG 1 | e | moderate-severe | moderate | moderate | moderate | moderate-severe | High shrink-swell, potential frost heave, slope, CL-SiC texture, moderate permeability, unified soil group |
| DVG 2 | c | moderate-severe | moderate | moderate | moderate | moderate-severe | High shrink-swell, wet spots, CL-SiC texture, moderate permeability, seasonally high water table, unified soil group |
| DVG 2 | d | moderate-severe | moderate- | moderate | moderate | moderate-severe | High shrink-swell, wet spots, CL-SiC texture, moderate permeability, seasonally high water table, unified soil group |
| DVG 3 | e | moderate-severe | moderate-severe | moderate-severe | moderate-severe | moderate-severe | High shrink-swell, depth to bedrock, slope, moderate permeability, CL-SiC texture |
| DVG 3 | fg | severe-very severe | severe-very severe | severe | severe-very severe | moderate-severe | Slope, high shrink-swell, depth to bedrock, CL-SiC texture |
| DVG 4 | c | severe | moderate | moderate | moderate | moderate-severe | High shrink-swell, CL-SiC texture, moderate permeability |
| DVG 4 | d | severe | moderate | moderate-severe | moderate | moderate-severe | High shrink-swell, flooding hazard, moderate permeability, CL-SiC texture |
| DWHP 1 | b | very severe | very severe | severe | very severe | very severe | Flooding hazard, seasonally high water table, potential frost action, drainage class |
| DWHP 1 | c | very severe | very severe | severe | very severe | very severe | Flooding hazard, seasonally high water table, potential frost heave, drainage class |
| DWT 1 | ab | very severe | very severe | severe | very severe | very severe | Flooding hazard, seasonally high water table, potential frost action, drainage class |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| DWT 2 | a | very severe | very severe | severe | very severe | very severe | Flooding hazard, seasonally high water table, potential frost heave, depth to bedrock, drainage class |
| DWT 3 | a | very severe | very severe | severe | very severe | very severe | Flooding hazard, seasonally high water table, organic soils, potential frost action |
| EBAD 1 | c | moderate | moderate-severe | slight-moderate | slight-moderate | slight-moderate | Potential frost action, shrink-swell, unified soil group, moderate permeability, soil texture |
| EBAD 2 | d | moderate | moderate-severe | slight-moderate | slight-moderate | slight-moderate | Potential frost heave, shrink-swell, unified soil group, wet spots, moderate permeability |
| ELRS 1 | c | severe | severe | severe | severe-very severe | severe-very severe | High shrink-swell, potential frost heave, C-SiC soil texture, very slow permeability, drainage class |
| ELRS 1 | d | severe | severe | severe | severe-very severe | severe-very severe | High shrink-swell, potential frost heave, C-SiC soil texture, very slow permeability, drainage class |
| ELRS 1 | e | severe | severe | severe | severe-very severe | severe-very severe | High shrink-swell, potential frost heave, C-SiC texture, very slow permeability, drainage class |
| ELRS 2 | c | severe | severe | severe | severe-very severe | severe-very severe | High shrink-swell, potential frost heave, C-SiC texture, depth to sand and gravel, very slow permeability |
| ELRS 3 | e | severe | severe | severe | severe-very severe | severe-very severe | High shrink-swell, potential frost heave, C-SiC texture, very slow permeability, drainage class |
| ELRS 3 | fg | very severe | very severe | severe | very severe | severe-very severe | Slope, high shrink-swell, potential frost heave, C-SiC texture, very slow permeability, drainage class |
| ELRS 4 | cd | severe | severe | severe | severe-very severe | severe-very severe | High shrink-swell, potential frost action, wet spots, high clay content, C-SiC texture |
| FSH 1 | b | moderate-severe | moderate-severe | moderate-severe | very severe | severe-very severe | Shrink-swell, potential frost heave, heavy clay content, C texture, slow permeability, drainage class |
| FSH 1 | c | moderate-severe | moderate-severe | moderate-severe | very severe | very severe | Shrink-swell, potential frost heave, heavy clay content, C texture, slow permeability, drainage |
| FSH 1 | d | moderate-severe | moderate-severe | moderate-severe | very severe | very severe | Shrink-swell, potential frost heave, heavy clay content, C texture, slow permeability, drainage class |
| FSH 2 | b | moderate-severe | moderate-severe | severe | very severe | severe-very severe | Wetspots, shrink-swell, potential frost action, C texture, seasonally high water table |
| FSH 2 | c | moderate-severe | moderate-severe | severe | very severe | severe-very severe | Wet spots, shrink-swell, potential frost action, C texture, seasonally high water table |
| FSH 2 | d | moderate-severe | moderate-severe | severe | very severe | severe-very severe | Wet spots, shrink-swell, potential frost action, C texture, seasonally high water table |
| FSH 3 | c | moderate-severe | moderate-severe | moderate-severe | very severe | severe-very severe | High clay content, shrink-swell, potential frost action, united soil group, slow permeability |

Table 12. (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| FSH 3 | d | moderate-severe | moderate-severe | moderate | very severe | severe-very severe | Heavy clay content, shrink-swell, potential frost action, unified soil group, slow permeability |
| FSH 4 | cd | moderate-severe | moderate-severe | severe | very severe | severe-very severe | Heavy clay content, shrink-swell, potential frost action, wet spots, seasonally high water table |
| FSH 5 | d | moderate-severe | moderate-severe | severe | very severe | severe-very severe | Heavy clay content, shrink-swell, potential frost action, slow permeability, drainage class |
| HIBO 1 | b | slight | moderate-severe | moderate-severe | moderate-severe | very severe | Flooding hazard, very gravelly subsoils, depth to sand and gravel, rapid permeability, groundwater contamination hazard |
| HIBO 1 | c | slight | moderate-severe | moderate-severe | moderate-severe | moderate-severe | Flooding hazard, very gravelly subsoils, depth to sand and gravel, groundwater contamination hazard, rapid permeability |
| HIW 1 | v | slight | slight | severe | slight-moderate | severe-very severe | Sandy soils, depth to sand and gravel, groundwater contamination hazard, rapid permeability |
| HIW 1 | c | slight | slight | severe | slight-moderate | severe-very severe | Depth to sand and gravel, sandy soils, groundwater contamination hazard, rapid permeability |
| HPAD 1 | c | slight-moderate | slight-moderate | slight | slight | slight-moderate | Unified soil group, SL-CL texture potential frost heave |
| HPAD 1 | d | slight-moderate | slight-moderate | slight | slight | slight-moderate | Slope, unified soil group, potential frost heave, SL-CL texture |
| HPAD 3 | d | slight-moderate | slight-moderate | slight | slight | slight-moderate | Slope, unified soil group, potential frost heave, SL-CL texture |
| HPAD 3 | e | moderate | moderate | moderate | moderate | slight-moderate | Slope, unified soil group, potential frost heave, SL-CL texture |
| HPAD 4 | e | moderate | moderate | moderate | moderate | slight-moderate | Slope, unified soil group, potential frost heave, SL-CL texture, depth to sand and gravel |
| HPV 1 | cb | slight | slight | moderate | slight | severe | Rapid permeability, SL-LS texture |
| HPV 2 | d | slight | slight | moderate | slight | severe | Rapid permeability, SL-LS texture |
| HPV 2 | e | moderate | moderate | moderate | moderate | sever | Slope, SL-LS texture, rapid permeability |
| HPV 3 | d | slight | slight-moderate | moderate | slight | severe | Slope, SL-LS texture, rapid permeability |
| HPSC 1 | d | slight | slight | moderate-severe | moderate-severe | very severe | Some gravelly soils, rapid permeability, stoniness, depth to sand and gravel, SL-LS texture |
| IND 1 | ab | severe | severe | severe | very severe | very severe | Shrink-swell, potential frost heave, Flooding hazard, wetness, seasonally high water table |
| IND 2 | b | severe | severe | severe | very severe | very severe | Shrink-swell, potential frost heave, flooding hazard, wetness, seasonally high water table |
| IND 2 | c | severe | severe | severe | very severe | very severe | Shrink-swell, potential frost heave, flooding hazard, wetness, seasonally high water table |
| LLK 1 | b | moderate | slight-moderate | slight-moderate | moderate-severe | slight-moderate | Shrink-swell, moderate permeability, potential frost heave, SiCL texture |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| LLK 1 | c | moderate | slight-moderate | slight-moderate | moderate-severe | slight-moderate | Potential frost heave, SiCL texture, shrink-swell, moderate permeability |
| LLK 1 | d | moderate | slight-moderate | slight-moderate | moderate-severe | slight-moderate | Potential frost heave, SiCL texture, shrink-swell, moderate permeability |
| LLK 2 | b | moderate-severe | moderate | moderate | severe | moderate | Shrink-swell, SiCL texture, seasonally high water table, wetness, moderate permeability, wet spots, potential frost heave, salinity |
| LLK 3 | d | moderate | slight-moderate | slight-moderate | moderate-severe | slight-moderate | Shrink-swell, SiCL texture, potential frost heave, moderate permeability |
| LLK 3 | e | moderate | moderate | moderate | moderate-severe | slight-moderate | Shrink-swell, SiCL texture, slope, moderate permeability, potential frost heave |
| LLK 3 | f | severe | severe | severe | severe | moderate | Shrink-swell, SiCL texture, slope moderate permeability, potential frost heave |
| LLK 4 | c | slight-moderate | slight | slight-moderate | moderate-severe | moderate | Shrink-swell, SiCL texture, depth to sand and gravel, moderate permeability |
| LTC 1 | e | moderate-severe | moderate | moderate | moderate | moderate | Shrink-swell, SiCL texture, depth to bedrock, slope, potential frost heave, moderate permeability |
| LTC 1 | f | severe | severe | severe | severe | moderate | Shrink-swell, SiCL texture, depth to bedrock, slope, potential frost heave, moderate permeability |
| LTC 1 | g | very severe | very severe | severe | very severe | severe | Shrink-swell, SiCL texture, depth to bedrock, slope, potential frost heave, moderate permeability |
| LTC 2 | c | moderate | moderate | moderate | moderate | moderate | Shrink-swell, SiCL texture, depth to bedrock, slope, potential frost heave, moderate permeability |
| LTC 2 | d | moderate | moderate | moderate | moderate | moderate | Shrink-swell, SiCL texture, depth to bedrock, slope, potential frost heave, moderate permeability |
| MDAD 1 | c | slight-moderate | slight-moderate | slight-moderate | slight | slight-moderate | Shrink-swell, SL-CL texture, potential frost heave |
| MDAD 1 | d | slight-moderate | slight-moderate | slight-moderate | slight | slight-moderate | Shrink-swell, SL-CL texture, potential frost heave |
| MDP 1 | c | slight-moderate | slight-moderate | slight-moderate | slight | slight | Shrink-swell, potential frost heave, |
| MDP 1 | d | slight-moderate | slight-moderate | slight-moderate | slight | slight | Shrink-swell, potential frost heave |
| MDP 2 | d | moderate | slight-moderate | moderate | moderate | very severe | Shrink-swell, wet spots, seasonally high water table, wetness, groundwater contamination hazard, rapid permeability, potential frost heave |
| MD-L 1 | c | moderate | severe | severe | severe | very severe | Depth to bedrock, potential frost heave, shrink-swell |
| MSB 1 | f | severe | severe | severe | severe | very severe | Depth to bedrock, slope, potential frost heave |
| MSB 1 | gh | very severe | very severe | severe | very severe | very severe | Depth to bedrock, slope, potential frost heave |
| NSK 1 | c | moderate | severe | moderate-severe | moderate-severe | moderate-severe | Depth to bedrock, CL texture, flooding hazard, seasonally high water table, shrink-swell, potential frost heave |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| NSK 2 | bd | very severe | very severe | severe | very severe | very severe | Depth to bedrock, potential frost heave, seasonally high water table, flooding hazard, shrink-swell |
| NSK 3 | b | moderate | severe | severe | severe | severe | Depth to bedrock, potential frost heave, seasonally high water table, flooding hazard, shrink-swell |
| POT 1 | ab | very severe | very severe | severe | very severe | very severe | Seasonally high water table, wetness, flooding hazard, C texture, potential frost heave, AASHO |
| POT 2 | ab | severe | severe-very severe | severe | very severe | very severe | Seasonally high water table, wetness, flooding hazard, C texture, potential frost heave, AASHO |
| POT 2 | c | severe | severe-very severe | severe | very severe | very severe | Seasonally high water table, wetness, flooding hazard, C texture, potential frost heave, AASHO |
| POT 3 | bd | very | very severe | severe severe | very severe | very severe | Seasonally high water table, wetness, flooding hazard, C texture, potential frost heave, AASHO |
| RB 1 | e | moderate-severe | moderate | moderate-severe | moderate-severe | moderate-severe | Depth to bedrock, slope, unified soil group, shrink-swell, AASHO |
| RB 1 | f | severe | severe | severe | severe | moderate-severe | Depth to bedrock, slope, shrink-swell, AASHO |
| RB 1 | gh | very severe | very severe | very severe | very severe | severe-very severe | Depth to bedrock, slope, shrink-swell, AASHO |
| RB 2 | f | severe | severe | severe | severe | severe | Depth to bedrock, slope, shrink-swell, AASHO |
| RB 2 | gh | very severe | very severe | very severe | very severe | very severe | Depth to bedrock, slope, shrink-swell, AASHO |
| RB 4 | de | severe-very severe | severe | severe | severe | moderate-severe | Flooding hazard, wetness, slope, groundwater contamination hazard |
| RB 4 | f | very severe | severe | severe | severe | moderate-severe | Flooding hazard, wetness, slope |
| RB 4 | gh | very severe | very severe | severe | very severe | severe-very severe | Flooding hazard, wetness, slope |
| RB 5 | f | severe | severe | severe | severe | severe | AASHO, shrink-swell, slope, erosion hazard |
| RB 5 | gh | very severe | very severe | severe | very severe | severe-very severe | AASHO, shrink-swell, slope, erosion hazard |
| RKAD 1 | c | moderate | moderate | slight | slight-moderate | slight-moderate | Moderate shrink-swell, potential frost heave, moderate permeability, SiL-SiCL texture |
| RKAD 1 | d | moderate | moderate | slight | slight-moderate | slight-moderate | Moderate shrink-swell, potential frost heave, moderate permeability, SiL-SiCL texture |
| RKAD 2 | c | moderate | moderate | slight-moderate | moderate | slight-moderate | Moderate shrink-swell, potential frost heave, wet spots, seasonally high water table, SiL-SiCL texture, severe in depressions |
| RKAD 2 | d | moderate | moderate | slight-moderate | moderate | slight-moderate | Moderate shrink-swell, potential frost heave, wet spots, seasonally high water table, SiL-SiCL texture, severe in depressions |
| RKAD 3 | d | moderate | moderate | slight-moderate | slight-moderate | moderate-severe | Moderate shrink-swell, potential frost heave, depth to bedrock, moderate permeability, SiL-SiCL texture |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| RKAD 3 | e | moderate | moderate | moderate | moderate | moderate-severe | Moderate shrink-swell, potential frost heave, depth to bedrock, moderate permeability, SiL-SiCL texture |
| RKAD 4 | c | moderate | moderate-severe | slight | moderate | slight-moderate | Salinity, moderate shrink-swell, potential frost heave, moderate permeability, SiL-SiCL texture, seasonally high water table |
| RKAD 5 | c | moderate | moderate | slight | slight-moderate | slight-moderate | Moderate shrink-swell, potential frost heave, moderate permeability, SiL-SiCL texture |
| RKAD 5 | d | moderate | moderate | slight | slight-moderate | slight-moderate | Moderate shrink-swell, potential frost heave, moderate permeability, SiL-SiCL texture |
| SCO 1 | c | slight | slight | severe | slight | severe-very severe | Rapid permeability, stoniness, depth to sand and gravel, gravelly soil |
| SCO 1 | d | slight | slight | severe | slight | severe-very severe | Rapid permeability, stoniness, depth to sand and gravel, gravelly soil |
| SCO 2 | dc | slight | slight | severe | slight | severe-very severe | Rapid permeability, stoniness, depth to sand and gravel, gravelly soil |
| SCO 2 | e | moderate | moderate | severe | moderate | severe-very severe | Rapid permeability, stoniness, slope, depth to sand and gravel, gravelly soil |
| SCO 3 | bc | moderate-severe | moderate-severe | severe | severe | very severe | Rapid permeability, stoniness, flooding hazard, seasonally high water table, depth to bedrock, gravelly soil |
| SCO 3 | de | moderate-severe | moderate-severe | severe | severe | very severe | Rapid permeability, stoniness, flooding hazard, seasonally high water table, slope, depth to bedrock, gravelly soil |
| SPR 1 | d | moderate | moderate | moderate-severe | moderate-severe | moderate-severe | CL texture, depth to bedrock, shrink-swell, potential frost heave, moderate permeability, stoniness |
| SPR 1 | e | moderate | moderate | moderate-severe | severe | moderate-severe | CL texture, depth to bedrock, shrink-swell, potential frost heave, slow permeability, stoniness, slope |
| SPR 1 | f | severe | severe | severe | severe | moderate-severe | Slow permeability, depth to bedrock, CL texture, slope, stoniness, shrink-swell, potential frost heave |
| SPR 1 | gh | very severe | very severe | severe | severe severe | severe-very severe | Slow permeability, depth to bedrock, CL texture, slope, stoniness, shrink-swell, potential frost heave |
| SPR 2 | d | moderate | moderate | moderate | moderate-severe | moderate-severe | Slow permeability, depth to bedrock, CL texture, stoniness, shrink-swell, potential frost heave |
| SPR 2 | e | moderate | moderate | moderate-severe | severe | moderate- | Moderate permeability, depth to bedrock, CL texture, stoniness, slope, shrink-swell, potential frost heave |
| SPR 2 | fg | severe-very severe | severe-very severe | severe | severe-very severe | moderate-severe | Slow permeability, depth to bedrock, CL texture, stoniness, slope |
| SPY 1 | d | moderate | moderate | moderate | moderate-severe | moderate | Slow permeability, CL texture, potential frost heave, shrink-swell, unified soil group, stoniness |
| SPY 1 | e | moderate | moderate | moderate | moderate-severe | moderate | Slow permeability, CL texture, potential frost heave, shrink-swell, unified soil group, stoniness |
| SPY 1 | fg | severe-very severe | severe-very severe | severe | very | moderate-severe | Slow permeability, CL texture, potential frost heave, stoniness, slope |

**Table 12.** (continued)

| Soil unit | Slope phase | Suitabilities and limitations for: Road location | Permanent buildings | Urban services | Septic fields | Sanitary landfills | Reason(s) for rating: |
|---|---|---|---|---|---|---|---|
| SPY 2 | d | moderate-severe | moderate | moderate | moderate | moderate | Slow permeability, CL texture, potential frost heave, stoniness, wet spots, shrink-swell |
| SPY 2 | e | moderate-severe | moderate | moderate-severe | moderate-severe | moderate-severe | Slow permeability, CL texture, potential frost heave, stoniness, wet spots, shrink-swell, slope |
| SPY 2 | f | very severe | very severe | severe | very severe | severe | Slow permeability, CL texture, potential frost heave, stoniness, wet spots, shrink-swell, slope |
| SRC 1 | b | slight moderate | moderate-severe | slight | slight-moderate | severe | Rapid permeability, flooding hazard, groundwater contamination hazard, potential frost heave |
| SRC 2 | bd | moderate-severe | severe | severe | moderate-severe | very severe | Rapid permeability, flooding hazard, groundwater contamination hazard, potential frost heave, seasonally high water table, wetness |
| SRC 3 | b | slight-moderate | moderate-severe | slight | moderate | severe | Rapid permeability, flooding hazard, groundwater contamination hazard, potential frost heave, depth to sand and gravel |
| SRC 4 | bd | moderate-severe | moderate-severe | severe | moderate-severe | very severe | Rapid permeability, flooding hazard, groundwater contamination hazard, potential frost heave, depth to sand and gravel, seasonally high water table |
| SUD 1 | b | slight-moderate | moderate-severe | severe | severe | very severe | Rapid permeability, flooding hazard, groundwater contamination hazard, stoniness, seasonally high water table, gravelly soil |
| TBR 1 | bd | moderate | severe | severe | severe | very severe | Rapid permeability, flooding hazard, groundwater contamination hazard, S texture, seasonally high water table |
| TM 1 | a | severe | very severe | severe | very severe | very severe | Permanently wet, organic soils |
| TWS 1 | bd | slight-moderate | moderate-severe | slight | slight-moderate | moderate-severe | Potential frost heave, shrink-swell, flooding hazard |
| TWS 1 | d | slight-moderate | moderate-severe | slight-moderate | slight-moderate | moderate-severe | Potential frost heave, shrink-swell, flooding hazard |
| TWS 2 | bd | moderate-severe | severe | severe | severe | severe | Seasonally high water table, wetness, groundwater contamination hazard, flooding hazard, shrink-swell, potential frost heave |

**Table 13.** Recreational interpretations of the Calgary urban perimeter soil survey units.

| Soil unit | Slope phase | Suitability and limitations for: Camp areas | Picnic areas | Paths and trails | Reasons for rating |
|---|---|---|---|---|---|
| ADHP 1 | c | slight-moderate | slight-moderate | slight-moderate | Silty clay loam to sandy loam texture |
| ADHP 1 | d | slight-moderate | slight-moderate | slight-moderate | Silty clay loam to sandy loam texture |
| ADHP 2 | d | moderate | moderate | slight-moderate | Silty clay loam to sandy loam texture, severe in depressions |
| ADHP 3 | d | slight-moderate | slight-moderate | slight-moderate | Silty clay loam to sandy loam texture |
| ADHP 3 | e | moderate | moderate | slight-moderate | Silty clay loam to sandy loam texture, slope |
| ADHP 3 | f | severe | severe | moderate | Silty clay loam to sandy loam texture, slope |
| ATL 1 | c | moderate | moderate | slight-moderate | Texture |
| ATL 1 | d | moderate | moderate | slight-moderate | Texture |
| ATL 1 | e | moderate | moderate | slight-moderate | Texture, slope |
| ATL 2 | c | moderate | moderate | slight-moderate | Texture, wet spots, severe in depressions |
| ATL 2 | d | moderate | moderate | slight-moderate | Texture, wet spots, severe in depressions |
| ATL 3 | d | moderate | moderate | slight-moderate | Texture |
| ATL 3 | e | moderate | moderate | slight-moderate | Texture, slope |
| ATL 3 | f | severe | severe | moderate | Texture, slope |
| ATL 5 | c | moderate | moderate | slight-moderate | Texture |
| ATL 5 | de | moderate | moderate | slight-moderate | Texture |
| BED 1 | c | moderate | moderate | moderate | Texture, slow permeability, seasonally high water table |
| BED 2 | c | moderate | moderate | moderate | Texture, slow permeability, seasonally high water table |
| BED 3 | c | severe | severe | severe | Wetness, slow permeability, texture, seasonally high water table |
| BOV 1 | b | moderate-severe | moderate-severe | moderate-severe | Stoniness |
| BOV 1 | c | moderate-severe | moderate-severe | moderate-severe | Stoniness |
| BOV 2 | f | severe | severe | severe | Slope stoniness |
| BPW 1 | d | moderate | moderate | moderate | Silty clay loam texture |
| BRG 1 | b | severe | moderate-severe | moderate | Stoniness, texture |
| BZC 1 | a | very severe | very severe | very severe | Wetness, seasonally high water table |
| BZC 2 | bd | very severe | very severe | very severe | Wetness, seasonally high water table |
| BZC 3 | b | very severe | very severe | very severe | Wetness, seasonally high water table |
| BZC 4 | bc | very severe | very severe | very severe | Wetness, seasonally high water table |
| CON 1 | d | slight-moderate | slight-moderate | slight-moderate | Sandy loam texture |
| DEL 1 | b | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DEL 1 | c | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DEL 1 | d | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DEL 2 | c | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture, severe in depressions |
| DEL 3 | c | moderate-severe | moderate-severe | moderate-severe | Loam to silt loam texture, wet spots, seasonally high water table |
| DEL 4 | c | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DEL 5 | c | moderate-severe | moderate-severe | moderate-severe | Wetness, salinity, seasonally high water table |

**Table 13.** (continued)

| Soil *unit* | Slope *phase* | Suitability and limitations for: Camp *areas* | Picnic areas | Paths and trails | Reasons for rating |
|---|---|---|---|---|---|
| DEL 6 | b | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture, wet spots, severe in depressions, seasonally high water table |
| DEL 6 | c | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture, wet spots, severe in depressions, seasonally high water table |
| DEL 7 | c | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DEL 7 | d | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DEL 8 | db | severe | severe | moderate | Flooding hazard |
| DEL 9 | d | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DEL 9 | e | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture, slope |
| DERK 1 | b | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DERK 1 | c | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DERK 1 | d | slight-moderate | slight-moderate | slight-moderate | Loam to silt loam texture |
| DERK 2 | b | moderate | moderate | slight-moderate | Wet spots, loam to silt loam texture, severe in depressions |
| DERK 2 | c | moderate | moderate | slight-moderate | Wet spots, loam to silt loam texture, severe in depressions |
| DVFS 1 | d | moderate | moderate | moderate | Slope, silty clay loam texture |
| DVFS 1 | e | moderate | moderate | moderate | Slope, silty clay loam texture |
| DVFS 2 | e | moderate | moderate | moderate | Slope, silty clay loam texture, wet spots, severe in depressions |
| DVG 1 | c | moderate | moderate | moderate | Silty clay loam texture |
| DVG 1 | d | moderate | moderate | moderate | Silty clay loam texture |
| DVG 1 | e | moderate | moderate | moderate | Silty clay loam texture, slope |
| DVG 2 | c | moderate | moderate | moderate | Silty clay loam texture, wet spots, severe in depressions |
| DVG 2 | d | moderate | moderate | moderate | Silty clay loam texture, wet spots, severe in depressions |
| DVG 3 | e | moderate | moderate | moderate | Silty clay loam texture, slope |
| DVG 3 | fg | severe-very severe | severe-very severe | moderate-severe | Slope, silty clay loam texture |
| DVG 4 | c | moderate | moderate | moderate | Silty clay loam texture |
| DVG 4 | d | moderate | moderate | moderate | Silty clay loam texture |
| DWHP 1 | b | very severe | severe | severe | Flooding hazard, wetness, seasonally high water table |
| DWHP 1 | c | very severe | severe | severe | Flooding hazard, wetness, seasonally high water table |
| DWT 1 | ab | very severe | severe | severe | Flooding hazard, wetness, seasonally high water table |
| DWT 2 | a | very severe | severe | severe | Flooding hazard, wetness, seasonally high water table |
| DWT 3 | a | very severe | severe | very severe | Flooding hazard, wetness, seasonally high water table |
| EBAD 1 | c | moderate | moderate | slight-moderate | Texture, erosion hazard |
| EBAD 2 | d | moderate | moderate | slight-moderate | Texture, erosion hazard |
| ELRS 1 | c | severe | moderate-severe | severe | Slow permeability, C texture |

**Table 13.** (Continued)

| Soil unit | Slope phase | Suitability and limitations for: Camp areas | Picnic areas | Paths and trails | Reasons for rating |
|---|---|---|---|---|---|
| ELRS 1 | d | severe | moderate-severe | severe | Slow permeability, C texture |
| ELRS 1 | e | severe | moderate-severe | severe | Slow permeability, C texture |
| ELRS 2 | c | severe | moderate-severe | severe | Slow permeability, C texture |
| ELRS 3 | e | severe | moderate-severe | severe | Slow permeability, C texture |
| ELRS 3 | fg | very severe | severe-very severe | severe | Slope, slow permeability, C texture |
| ELRS 4 | cd | moderate-severe | moderate-severe | severe | Wet spots, slow permeability, C texture |
| FSH 1 | b | moderate-severe | moderate-severe | moderate-severe | Slow permeability, HC-SiC texture |
| FSH 1 | c | moderate-severe | moderate-severe | moderate-severe | Slow permeability, HC-SiC texture |
| FSH 1 | d | moderate-severe | moderate-severe | moderate-severe | Slow permeability, HC-SiC texture |
| FSH 2 | b | severe | severe | moderate-severe | Wet spots, slow permeability, SiC-HC texture |
| FSH 2 | c | severe | severe | moderate-severe | Wet spots, slow permeability, SiC-HC texture |
| FSH 2 | d | severe | severe | moderate-severe | Wet spots, slow permeability, SiC-HC texture |
| FSH 3 | c | moderate-severe | moderate-severe | moderate-severe | Slow permeability, SiC-HC texture, wet spots |
| FSH 3 | d | moderate-severe | moderate-severe | moderate-severe | Slow permeability, SiC-HC texture |
| FSH 4 | cd | severe | severe | moderate-severe | Wetness, slow permeability, SiC-HC texture |
| FSH 5 | d | moderate-severe | moderate-severe | moderate-severe | Slow permeability, SiC-HC texture |
| HIBO 1 | b | slight-moderate | slight-moderate | slight-moderate | Flooding hazard, stoniness |
| HIBO 1 | c | slight-moderate | slight-moderate | slight-moderate | Flooding hazard, stoniness |
| HIW 1 | b | slight | slight | slight | No significant limitation |
| HIW 1 | c | slight | slight | slight | No significant limitation |
| HPAD 1 | c | slight-moderate | slight-moderate | slight-moderate | SL texture |
| HPAD 1 | d | slight-moderate | slight-moderate | slight-moderate | SL texture |
| HPAD 3 | d | slight-moderate | slight-moderate | slight-moderate | SL texture |
| HPAD 3 | e | moderate | moderate | slight-moderate | Slope, SL texture |
| HPAD 4 | e | moderate | moderate | slight-moderate | Slope, SL texture |
| HPV 1 | cb | slight-moderate | slight-moderate | slight-moderate | SL texture, erosion hazard |
| HPV 2 | d | slight-moderate | slight-moderate | slight-moderate | SL texture, erosion hazard |
| HPV 2 | e | moderate | moderate | slight-moderate | Slope, SL texture, erosion hazard |
| HPV 3 | d | slight-moderate | slight-moderate | slight-moderate | SL texture, erosion hazard |
| HPSC 1 | d | moderate-severe | moderate-severe | moderate | Stoniness, SL texture |
| IND 1 | ab | very severe | very severe | very severe | Wetness, seasonally high water table |
| IND 2 | b | very severe | very severe | very severe | Flooding hazard, wetness |
| IND 2 | c | very severe | very severe | very severe | Flooding hazard, wetness |
| LLK 1 | b | moderate | slight | slight-moderate | Silty clay loam texture, moderately slow permeability |
| LLK 1 | c | moderate | slight | slight-moderate | Silty clay loam texture, moderately slow permeability |
| LLK 1 | d | moderate | slight | slight-moderate | Silty clay loam texture, moderately slow permeability |

**Table 13.** (continued)

| Soil unit | Slope phase | Suitability and limitations for: Camp areas | Picnic areas | Paths and trails | Reasons for rating |
|---|---|---|---|---|---|
| LLK 2 | b | moderate-severe | slight-moderate | moderate | Wetness, silty clay loam texture, moderately slow permeability, seasonally high water table |
| LLK 3 | d | moderate | slight | slight-moderate | Silty clay loam texture, moderately slow permeability |
| LLK 3 | e | moderate | slight | slight-moderate | Silty clay loam texture, moderately slow permeability |
| LLK 3 | f | severe | moderate | moderate | Slope, silty clay loam texture, moderately slow permeability |
| LLK 4 | c | moderate | slight | slight-moderate | Silty clay loam texture, moderately slow permeability |
| LTC 1 | e | moderate | moderate | slight-moderate | Slope, texture |
| LTC 1 | f | severe | severe | moderate | Slope, texture |
| LTC 1 | g | very severe | very severe | severe | Slope |
| LTC 2 | c | slight-moderate | slight-moderate | slight-moderate | Texture |
| LTC 2 | d | moderate | slight-moderate | slight-moderate | Slope, texture |
| MDAD 1 | c | slight | slight | slight | No significant limitation |
| MDAD 1 | d | slight | slight | slight | No significant limitation |
| MDP 1 | c | slight | slight | slight | No significant limitation |
| MDP 2 | d | slight | slight | slight | No significant limitation |
| MDP 2 | d | slight | slight | slight | Wet spots, severe in depressions |
| MD-L 1 | c | slight-moderate | slight-moderate | slight | Depth to bedrock |
| MSB 1 | f | severe | severe | moderate | Slope, depth to bedrock, texture |
| MSB 1 | gh | very severe | very severe | severe-very severe | Slope, depth to bedrock, texture |
| NSK 1 | c | moderate | moderate | slight-moderate | Flooding hazard, silty clay loam texture |
| NSK 2 | bd | severe | severe | severe | Flooding hazard, silty clay loam texture, seasonally high water table |
| NSK 3 | b | moderate-severe | moderate-severe | moderate-severe | Flooding hazard, silty clay loam texture, seasonally high water table |
| POT 1 | ab | very severe | very severe | very severe | Seasonally high water table, wet spots |
| POT 2 | ab | very severe | very severe | very severe | Seasonally high water table, wet spots, flooding hazard |
| POT 2 | c | very severe | very severe | very severe | Seasonally high water table, wet spots, flooding hazard |
| POT 3 | bd | very severe | very severe | very severe | Seasonally high water table, wet spots, flooding hazard |
| RB 1 | e | moderate | moderate | slight-moderate | Slope, texture |
| RB 1 | f | severe | severe | moderate | Slope |
| RB 1 | gh | very severe | very severe | severe-very severe | Slope |
| RB 2 | f | severe | severe | severe | Slope, depth to bedrock, erosion hazard |
| RB 2 | gh | very severe | very severe | very severe | Slope, depth to bedrock, erosion hazard |
| RB 4 | de | severe | severe | moderate | Flooding hazard, slope, texture |
| RB 4 | f | severe | severe | moderate | Slope, flooding hazard, texture |
| RB 4 | gh | very severe | very severe | severe-very severe | Slope, flooding hazard, texture |

**Table 13.** (continued)

| Soil unit | Slope phase | Suitability and limitations for: Camp areas | Picnic areas | Paths and trails | Reasons for rating |
|---|---|---|---|---|---|
| RB 5 | f | severe | severe | severe | Slope, erosion hazard, texture |
| RB 5 | gh | very severe | very severe | very severe | Slope, erosion hazard, texture |
| RKAD 1 | c | moderate | moderate | moderate | Silt loam to silty clay loam texture |
| RKAD 1 | d | moderate | moderate | moderate | Silt loam to silty clay loam texture |
| RKAD 2 | c | moderate | moderate | moderate | Wet spots, severe in depressions |
| RKAD 2 | d | moderate | moderate | moderate | Wet spots, texture, severe in depressions |
| RKAD 3 | d | moderate | moderate | moderate | Silt loam to silty clay loam texture |
| RKAD 3 | e | moderate | moderate | moderate | Slope, silt loam to silty clay loam texture |
| RKAD 4 | c | moderate | moderate | moderate | Slow permeability, texture |
| RKAD 5 | c | moderate | moderate | moderate | Silt loam to silty clay loam texture |
| RKAD 5 | d | moderate | moderate | moderate | Silt loam to silty clay loam texture |
| SCO 1 | c | severe | moderate | moderate | Stoniness |
| SCO 1 | d | severe | severe | severe | Stoniness |
| SCO 2 | dc | severe | severe | severe | Stoniness |
| SCO 2 | e | severe | severe | severe | Stoniness |
| SCO 3 | bc | severe | moderate-severe | moderate-severe | Seasonally high water table, stoniness, depth to bedrock, flooding hazard |
| SCO 3 | de | severe | moderate-severe | moderate-severe | Seasonally high water table, stoniness, depth to bedrock, flooding hazard |
| SPR 1 | d | moderate | moderate | moderate | Moderately slow permeability, stoniness, texture |
| SPR 1 | e | moderate | moderate | moderate | Moderately slow permeability, slope, stoniness, texture |
| SPR 1 | f | severe | severe | moderate | Slope, moderately slow permeability, stoniness, texture |
| SPR 1 | gh | very severe | very severe | severe-very severe | Slope, moderately slow permeability, stoniness, texture |
| SPR 2 | d | moderate-severe | moderate | moderate | Moderately slow permeability, stoniness, texture |
| SPR 2 | e | moderate-severe | moderate | moderate | Slope, moderately slow permeability, stoniness, texture |
| SPR 2 | fg | very severe | severe-very severe | moderate-severe | Slope, moderately slow permeability, stoniness, texture, depth to bedrock |
| SPY 1 | d | moderate | moderate | slight-moderate | Moderately slow permeability, stoniness, texture |
| SPY 1 | e | severe | moderate | slight-moderate | Slope, moderately slow permeability, stoniness, texture |
| SPY 1 | fg | very severe | severe-very severe | moderate-severe | Slope, moderately slow permeability, stoniness, texture |
| SPY 2 | d | moderate-severe | moderate | moderate | Wet spots, slope, moderately slow permeability, stoniness, texture |
| SPY 2 | e | very severe | moderate | moderate | Wet spots, slope, moderately slow permeability, stoniness, texture, severe in depressions |
| SPY 2 | f | very severe | severe | moderate | Wet spots, slope, moderately slow permeability, stoniness, texture, severe in depressions |

**Table 13.** (continued)

| Soil unit | Slope phase | Suitability and limitations for: Camp areas | Picnic areas | Paths and trails | Reasons for rating |
|---|---|---|---|---|---|
| SRC 1 | b | slight-moderate | slight-moderate | slight-moderate | Flooding hazard |
| SRC 2 | bd | severe | severe | severe | Flooding hazard, seasonally high water table |
| SRC 3 | b | slight-moderate | slight-moderate | slight-moderate | Flooding hazard |
| SRC 4 | bd | moderate-severe | moderate-severe | moderate-severe | Flooding hazard, seasonally high water table, wetness |
| SUD 1 | b | moderate-severe | moderate | moderate | Flooding hazard, stoniness, texture |
| TBR 1 | bd | moderate | moderate | moderate | Flooding hazard, seasonally high water table, texture |
| TM 1 | a | very severe | very severe | very severe | Permanently wet organic soils |
| TWS 1 | bc | moderate | moderate | moderate | Flooding hazard, texture |
| TWS 1 | d | moderate | moderate | moderate | Flooding hazard, texture |
| TWS 2 | bd | severe-very severe | severe | severe | Flooding hazard, seasonally high water table, wet spots, texture |

**Table 14.** Guide for developing soil interpretations for sources of topsoil

The purpose of this interpretation is to provide information for use by engineers, landscapers, nurserymen, planners, and others who make decisions about selection, stockpiling, and use of topsoil.

Topsoil has several meanings, but in soil survey interpretations it means soil material to spread over barren surfaces, usually made barren by construction, so as to improve soil conditions for re-establishment and maintenance of adapted vegetation; and to improve soil conditions lawns, gardens and flower beds where vegetation already may exist.

Good topsoil has physical, chemical, and biological characteristics favourable for the establishment and growth of adapted plants. It is friable and easy to handle and spread. While a high content of plant nutrients in good balance is desirable, it is less important than responsiveness to fertilization, and to liming if pH adjustments are necessary (United States Department of Agriculture, undated).

A soil that qualifies as a good source not only provides a source of topsoil for removal and transfer to another place, but also has characteristics such that, with material stripped off for topsoil, the remaining soil is reclaimable. Some damage to a borrow area is to be expected, but if the damage is great enough so that revegetation and erosion control become major problems, the soil should be rated as a poor source of topsoil regardless of the quality of the surface materials. This constraint does not apply to construction sites where the soils are drastically disturbed in the construction process; and topsoil ratings of soils for such places therefore may be different. Unless otherwise specified, however, the assumption is made that localities from which topsoil is taken are to be restored.

Also considered in rating soil as a source of topsoil are certain features that affect the ease or difficulty of excavating the material, particularly the slope, wetness, and thickness of suitable material. Usually, only the surface layer is rated; but if this is less than about 15 cm thick, assume that it will be mixed with the adjacent layer to make up a thickness of at least 15 cm and rate this mixture.

**Soil suitability classes for sources of topsoil.**

| Properties affecting use | Degree of suitability | | | |
|---|---|---|---|---|
| | Good | Fair | Poor | Very poor |
| Moist consistence[1] | Very friable, friable | Loose, firm | Very firm | Cemented |
| Flooding | None | May flood occasionally for short periods | Frequent flooding | Constantly flooded |
| Wetness[2] (soil drainage class) | Wetness not determining if better than poorly drained | | Poorly drained soils | Very poorly drained and permanently wet soils |
| Slope[3] | 0-9% (aA-dD) | >9-15% (eE) | >15-30% (fF) | >30% (gG, hH) |
| Surface stoniness[4] | 0 and 1 | 2 | 3 and 4 | 5 |
| Texture[5] | FSL, VFSL, L, SiL, SL; SC if 1:1 clay is dominant | CL, SCL, SiCL; SC if 2:1 clay is dominant; C and SiC if 1:1 clay is dominant | S, LS; C and SiC if 2:1 clay is dominant Organic soils[6] | |
| Thickness[7] of Ah horizon | >25 cm | 15-25 cm | 8-15 cm | <8 cm |
| Topsoil salinity | E.C.[8] - 0-1 | E.C. >1-3 | E.C. >3-8[9] | E.C. >8[9] |

1 Terms used to describe soil consistence are defined in Greenlee (1981).
2 Soil drainage classes defined in Greenlee (1981).
3 Influences ease of excavation, and susceptibility to soil erosion after topsoil has been removed. See section entitled "Soil Erodibility".
4 Surface stoniness for the purpose of this table includes gravels and cobbles, or any coarse fragments >2 mm in diameter. Some gravelly soils may be rated none to slight when the content of gravel exceeds 20% by only a small margin if (a) the gravel is embedded in the soil matrix, or (b) the fragments are <2 cm in diameter. Surface stoniness classes are defined in Greenlee (1981).
5 The soil textural classes are defined in the glossary.
6 Non-woody organic materials are assessed as good sources for topsoil if mixed with or incorporated into mineral soil.
7 Defined in this report as "Thickness of Topsoil".
8 E.C. means electrical conductivity and is explained in the glossary.
9 These limits are taken from Richards (1954).

**Table 15.** Guide for developing soil interpretations for sources of sand or gravel

The purpose of this interpretation is to provide guidance on the probable supply of sand or gravel.

Ratings are based on the probability that soils contain sizeable quantities of sand or gravel, excluding soft materials such as shale or siltstone. The interpretation pertains mainly to the characteristics of the soil substratum to a depth of 150 cm and to qualify as either a good or fair probable source, the layer should be at least about 1 m thick. All of this however, need not be in the top 1 to 2 m. If the approximate lowest 15 cm of this section is sand or gravel, and from observations made in deep cuts and other evidence, including geological, the sand or gravel reached at the bottom of this section is known to extend downward for several meters, the thickness requirement is satisfied.

Only the suitability as a source of sand or gravel is rated. No attempt is made to rate the quality of the sand or gravel for specific uses, such as road base or concrete. However, quality determinations should be made at the site of the source, since both grain sizes, and shapes of sand and gravel determine the suitability for specific uses (Olsen 1971).

A particular area outlined on the soil map can be identified as predominantly sand or predominantly gravel by consulting the soil report for a description of the soil unit under consideration.

**Soil suitability classes for sources of sand or gravel.**

| Properties affecting use | Degree of suitability | | | |
|---|---|---|---|---|
| | **Good** | **Fair** | **Poor** | **Very poor** |
| Flooding[1] | Infrequent (once in 5 years) | Occasional (once in 2-4 years) | Frequent (every year) | Constantly flooded |
| Wetness[1,2] (soil drainage class) | Very rapidly, rapidly well and moderately well-drained soils - no seepage or ponding Seasonal[3] WT >150 cm | Moderately well-drained soils - occasional seepage or ponding. Imperfectly drained soils - no seepage or ponding. Seasonal WT 100-150 cm. | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils. Seasonal WT 50-10 0 cm. | Permanently wet soils. WT <50 cm |
| Unified soil group | SW, SP, GW, GP | SW-SM, SP-SM, GW-GM, GP-GM | SM, SW-S C, SP-SC, GM, GW-G C, GP-GC | All other groups and bedrock |
| Depth to sand and gravel | <50 cm | 50-100 cm[4] | >100 cm[4] | |
| Rockiness[5] | Rock exposures >25 m apart and cover <10% of the surface. | Rock exposures 10-25 m apart and cover 10-25% of the surface. | Rock exposures 2-10 m apart and cover 25-50% of the surface. | Rock exposures 2 m or less apart and cover 50-90% of the surface. |

1 Affects accessibility and ease of excavation.
2 Soil drainage classes defined in Greenlee (1981).
3 Seasonal means for more than 1 month.
4 Rated good if it is known that the underlying gravel or sand deposit is thick (>150 cm).
5 Rockiness classes are outlined in The Canadian System of Soil Classification (Canada Soil Survey Committee, 1978).

**Table 16.** Guide for developing soil interpretations for sources of roadfill

These ratings reflect how well a soil performs after it is removed from its original location and placed in a road embankment elsewhere. They also reflect evaluation of other characteristics, such as slope, that determine the ease or difficulty in getting the soil out.

Since roadfill is soil materials used for making embankments for roads and because low embankments or the upper part of high embankments serve as the subgrade for the road, soil material good for roadfill must also be good for subgrade. Most of the comments pertaining to soil material used for road location are also pertinent to soil material and used for sources of roadfill.

Since soil survey interpretations are oriented to local roads and streets rather than to super highways, it is assumed that suitability ratings are evaluations of the soils as sources of roadfill for low embankments, generally less than 2 m high, and less exacting in design than high embankments.

Generally, the rating is given for the whole soil, from the surface to a depth of 1 to 2 m, based on the assumption that soil horizons will be mixed in loading, dumping, and spreading. If the surface layer from a few cm to as much as about 30 cm in thickness is poorly suited for roadfill, disregard the surface layer in establishing the rating. If the thickness of suitable material is less than about 1 m because of shallow depth to bedrock or other unsuited or poorly suited material, the whole soil is given a rating of poor, regardless of the material less than 1 m thick.

**Soil suitability classes for sources of roadfill.**

| Properties affecting use[1] | Degree of suitability | | | |
|---|---|---|---|---|
| | **Good** | **Fair** | **Poor** | **Very poor** |
| Shrink-swell Potential | Low - Unified Groups, GW, GP, SW, SP, GM, GC[2], SM, SC[2] | Moderate - Unified Groups CL with P.I.[3] <15, ML | High - Unified Groups CL with P.I. >15, CH, MH[4] | Very High - Unified Groups OL, OH, Pt |
| AASHO Group Index | 0-4 | 5-8 | >8 | |
| Potential frost action[5] | Low (F1, F2) | Moderate (F3) | High (F4) | |
| Flooding | Infrequent (once in 5 years) | Occasional (once in 2-4 years) | Frequent (every year) | Constantly flooded |
| Wetness[6] (soil drainage class) | Very rapidly, rapidly, well and moderately well-drained soils - no seepage or ponding. Seasonal WT >150 cm. | Moderately well-drained soils - occasional seepage or ponding. Imperfectly drained soils - no seepage or ponding. Seasonal WT 100-150 cm. | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils. Seasonal WT 50-100 cm. | Permanently wet soils. WT <50 cm |
| Slope | 0-15% (aA-eE) | >15-30% (fF) | >30-60% (gG) | >60% (hH) |
| Depth to bedrock | >100 cm | 50-100 cm | 20-25 cm | <20 cm |
| Surface stoniness[8] | 0, 1 and 2 | 3 | 4 | 5 |
| Rockiness[9] | Rock exposures >25 m apart and cover <10% of the surface | Rock exposures 10-25 m apart and cover 10-25% of the surface | Rock exposures 2-10 m apart and cover 25-50% of the surface | Rock exposures 2 m or less apart and cover 50-90% of the surface |

1 The first three items pertain to soil after it is placed in a fill; the last six items pertain to soil in its natural condition before excavation for roadfill.
2 Downgrade to fair if content of fines (<200 mesh) is more than about 30%.
3 P.I. means Plasticity Index and is defined in the glossary.
4 Upgrade to fair if MH is largely Kaolinitic, friable, and free of mica.
5 Frost heave is important where frost penetrates below the paved or hardened surface layer, and moisture transportable by capillary movement is sufficient to form ice lenses at the freezing point. The potential frost action classes are outlined in Greenlee (1981).
6 Soil drainage class defined in Greenlee (1981).
7 Seasonal means for more than one month.
8 Surface stoniness classes are outlined in Guidebook for use with Soil Survey Report of Alberta Provincial Parks and Recreation Areas (Greenlee 1981).
9 Rockiness classes are outlined in The Canadian System of Soil Classification (Canada Soil Survey Committee (1978).

**Table 17.** Guide for developing soil interpretations for road location

This guide applies to soils evaluated for construction and maintenance of local roads, streets, and parking areas. These are improved roads and streets having some kind of all weather surfacing, commonly asphalt or gravel, and are expected to carry automobile traffic all year. They consist of:

1. underlying local soil material (either cut or fill) called the subgrade;
2. the base material of gravel, crushed rock or stabilized soil called the subbase; and
3. the actual road surface or pavement, either flexible or rigid.

They also are graded to shed water, and have ordinary provisions for drainage. With the probable exception of the hardened surface layers, the roads and streets are built mainly from the soil at hand, and cuts and fills are limited, usually less than 2 m. Excluded from consideration in this guide are highways designed for fast moving, heavy trucks.

Properties that affect design and construction of roads and streets are:

1. those that affect the load supporting capacity and stability of the subgrade, and
2. those that affect the workability and amount of cut and fill.

The AASHO and Unified Classification, and the shrink-swell potential give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope, depth to bedrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill required to reach an even grade.

**Soil limitation classes for road location.**

| Properties affecting use | Degree of limitation | | | |
|---|---|---|---|---|
| | **None to Slight** | **Moderate** | **Severe** | **Very severe** |
| Flooding[1] | None | Infrequent (once in 5 years) | Occasional (once in 2-4 years) | Frequent (every year) |
| Wetness[2] (soil drainage class) | Very rapidly, rapidly, well and moderately well-drained soils - no seepage or ponding. Seasonal[3] WT >150 cm | Moderately well-drained soils - occasional seepage or ponding, imperfectly drained soils - no seepage or ponding. Seasonal WT 100-150 cm. | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils. Seasonal WT 50-10 0 cm. | Permanently wet soils WT <50 cm |
| Slope[1] | 0-9% (aA-dD) | >9-15% (eE) | >15-30% (fF) | >30% (gG, hH) |
| Shrink-swell potential[4] | Low - Unified Groups GW, GP, SW, SP, GM, GC[5], SM, SC[5] | Moderate - Unified Groups CL with P.I.[6] <15, ML | High - Unified Groups C L with P.I. >15, CH , MH, OH, OL, Pt | |
| AASHO group index | 0-4 | 5-8 | > | |
| Potential frost action[7] | Low (F1, F2) | Moderate (F3) | High (F4) | |
| Depth to bedrock[8] | >100 cm | 50-100 cm | <50 cm | |
| Surface stoniness[9] | 0, 1 and 2 | 3 | 4 | 5 |
| Rockiness[10] | Rock exposures >75 m apart and cover <2% of the surface | Rock exposures 25-75 m apart and cover 2-10% of the surface | Rock exposures <25 m apart and cover >10% of the surface | Rock exposures too frequent to permit location of roads and streets. |

[1] Applies to road location.
[2] Soil drainage classes defined in Greenlee (1981).
[3] Seasonal means for more than one month.
[4] This item estimates the strength of the soil as it applies to roadbeds. The limitations were estimated assuming that the roads would be surfaced. On unsurfaced roads, rapidly drained, very sandy, poorly graded soils may cause washboard or rough roads.
[5] Downgrade to moderate if content of fines (<200 mesh) is greater than about 30%.
[6] P.I. means plasticity index and is defined in the glossary.
[7] Frost heave is important where frost penetrates below the paved or hardened surface layer, and moisture transportable by capillary movement is sufficient to form ice lenses at the freezing point. The potential frost action classes are outlined in Greenlee (1981).
[8] If bedrock is soft enough to be dug with light power equipment and is rippable by machinery, reduce moderate and severe limitations by one class.
[9] Surface stoniness classes are outlined in Guidebook for use with Soil Survey Report or Alberta Provincial Parks and Recreation Areas (Greenlee 1981).
[10] Rockiness classes are outlined in The Canadian System of Soil Classification (Canada Soil Survey Committee, 1978).

**Table 18.** Guide for developing soil interpretations for permanent buildings

This guide provides ratings for undisturbed soils that are evaluated for single family dwellings and other structures with similar foundations; but slope, susceptibility to flooding, and seasonal wetness, that have effects beyond those related exclusively to foundations, are also considered. The properties affecting foundation support are those that affect bearing capacity and settlement under load, and those that affect excavation and construction costs. The properties affecting bearing strength and settlement of the natural soil are density, wetness, plasticity, texture, and shrink-swell behavior. Shrink-swell potential and plasticity (Atterberg limits) are inferred from the Unified Soil Classification. Properties influencing the ease and amount of excavation are wetness, slope, depth to bedrock and sand or gravel, stoniness and rockiness. These properties also affect the ease of installing underground utilities. Excluded are limitations for septic tank absorption (see Table 20) and lawns and landscaping. On site investigations are needed for specific placement of buildings and utility lines, and for detailed design of foundations. All ratings are based on undisturbed soils to a depth of 1 to 2 m.

**Soil limitation classes for permanent buildings.**

| Properties affecting use | Degree of limitation | | | |
|---|---|---|---|---|
| | **None to Slight** | **Moderate** | **Severe** | **Very severe** |
| Flooding | None | None | Occasional (once in 5 years) | Frequently (every year) |
| Wetness[1] (soil drainage class) | WITH BASEMENTS: very rapidly, rapidly and well-drained soils. WT >150 cm<br>WITHOUT BASEMENTS: very rapidly, rapidly, well and moderately well-drained soils - no seepage or ponding. WT >75 cm | WITH BASEMENTS: moderately well-drained soils - no seepage or ponding. WT 75-150 cm.<br>WITHOUT BASEMENTS: moderately well-drained soils - occasional seepage or ponding. Imperfectly drained soils - no seepage WT 50-75 cm. | WITH BASEMENTS: imperfectly drained soils - seepage or ponding. poorly and very poorly drained soils. WT 25-75 cm 1 month or more during year.<br>WITHOUT BASEMENTS: poorly and very poorly drained soils. WT 25-50 cm 1 month or more during year. | WITH BASEMENTS: permanently wet soils. WT <25 cm.<br>WITHOUT BASEMENTS: permanently wet soils. WT <25 cm |
| Slope[2] | 0-9% (aA-dD) | >9-15% (eE) | >15-30% (fF) | >30% (gG, hH) |
| Shrink-swell potential[3] | Low - Unified Groups GW, GP, SW, SP, GM, GC, SM, SC, and CL with P.I.[4] <15 | Moderate[5] - Unified Groups ML, and CL with P.I. >15 | High[5] - Unified Groups CH, MH, OL and OH | Very High[5] - Unified Group Pt |
| Potential frost action[6] | Low (F1, F2) | Moderate (F3)[5] | High (F4)[5] | |
| Depth to bedrock[7] | WITH BASEMENTS: >150 cm<br>WITHOUT BASEMENTS: >100 cm | WITH BASEMENTS: 100-150 cm<br>WITHOUT BASEMENTS: 50-100 cm | WITH BASEMENTS: 50-100 cm<br>WITHOUT BASEMENTS: <50 cm | WITH BASEMENTS: <50 cm |
| Potential sulfate attack[8] on concrete | 0-1000 ppm[9] or 0-0.20% | 1000-2000 ppm or 0.20-0.50% | >2000 ppm or >0.50%[5] | |
| Surface stoniness[10] | 0 and 1 | 2 | 3 and 4 | 5 |
| Rockiness[7,11] | Rock exposures >75 m apart and cover <2% area. | Rock exposures 25-75 m apart and cover 2-10% of the area. | Rock exposures <25 m apart and cover >10% of the area. | Rock exposures too frequent to permit location of permanent buildings. |

1 Soil drainage classes defined in Greenlee (1981).
2 Reduce the slope limits by one-half for soils subject to hillside slippage.
3 This item estimates the strength of the soil, that is, its ability to withstand applied loads.
4 P.I. means Plasticity Index, and is defined in the glossary.
5 These factors are limitations only where basements and underground utilities are planned.
6 Frost heave only applies where frost penetrates to the assumed depth of the footings and the soil is moist. The potential frost action classes are outlined in Greenlee (1981).
7 If bedrock is soft enough to be dug with light power equipment, such as a backhoe, moderate and severe limitations may be reduced by 1 class.
8 Categories for sulfate attach on concrete are outlined in Greenlee (1981).
9 ppm means parts per million.
10 Surface stoniness classes are outlined in Greenlee (1981).
11 Very shallow soils are rated as having a severe limitation for rockiness. Rockiness classes are defined in The Canadian Systems of Soil Classification (Canada Soil Survey Committee, 1978).

**Table 19.** Guide for developing soil interpretations for trench type sanitary landfills

The trench type sanitary landfill is a dug trench in which refuse is buried. Successive layers of refuse and soil material are put into the trench and compacted. Soil material excavated when digging the trench is used. The cover of soil material keeps the refuse in place and controls odors, fires, and rodents. A final cover of soil material at least 1 m thick is placed on the landfill when the trench is full.

This guide provides ratings for evaluating undisturbed soils on their suitability as sites for good sanitary landfills that should be useable all year, and should operate without contaminating water supplies or causing a health hazard. Because routine soil investigations are normally confined to depths of about 1 to 2 m, and many landfill operations use trenches as deep as 4 m or more, there is need for geological and hydrological knowledge to determine the potential for pollution of groundwater, as well as to obtain the design of a sanitary landfill. The presence of hard nonrippable bedrock, creviced bedrock, sandy or gravelly strata within or immediately underlying the proposed trench bottom is undesirable from the standpoint of excavation, and from the standpoint of the potential for groundwater pollution.

**Soil limitation classes for trench type sanitary landfills.**[1]

| Properties affecting use | Degree of limitation | | | |
|---|---|---|---|---|
| | **None to Slight** | **Moderate** | **Severe** | **Very severe** |
| Flooding | None | Rare | Occasional | Frequent |
| Wetness[2] (soil drainage class) | Very rapidly, rapidly and well drained soils. Seasonal[3] high WT >180 cm. | Moderately well-drained soils -no seepage or ponding. Seasonal high WT 120-180 cm | Moderately well-drained soils - occasional seepage or ponding, imperfectly drained soils - no seepage or ponding. Seasonal high WT 60-120 cm. Very rapidly and rapidly drained soils if groundwater contamination hazard | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils, permanently wet soils. Seasonal high WT <60 cm. |
| Slope | 0-15% (aA-eE) | >15-30% (fF) | >30-60% (gG) | >60% (hH) |
| Permeability[4] | Moderate to very slow inclusive. <5.0 cm/hr | Moderate to very slow inclusive. <5.0 cm/hr | Moderately rapid. 5.0-15.0 cm/hr | Rapid and very rapid. >15.0 cm/hr |
| Soil texture[5] (dominant to a depth of 150 cm) | SL, FSL, VFSL, L, SiL, SCL | SiCL, CL, SC, LS, Si[6] | SiC | C, S, gravel, peat, muck |
| Depth to Bedrock<br>Hard -<br>Rippable - | <br>>180 cm<br>>150 cm | <br>>180 cm<br>100-150 cm | <br>100-180 cm<br><100 cm | <br><100 cm |
| Surface stoniness[7] | 0 and 1 | 2 | 3 and 4 | 5 |
| Rockiness[8] | No rock exposures | No rock exposures | Rock exposures present | Rock exposures too frequent to permit location of sanitary landfills. |
| Nature of bedrock | Impermeable | Permeable[9] | Highly permeable[9], fractured, easily soluble | |
| Depth of sand or gravel[9] | >180 cm | >180 cm[9] | 100-180 cm[9] | <100 cm[9] |

1 Based on soil depth (120 cm) commonly investigated in making soil surveys. If it is probable that the soil material to a depth of 3-4 m will not alter a rating of slight or moderate, indicate that by an appropriate footnote such as "Probably slight to 4 m", or "Probably moderate to 4 m".

2 Soil drainage classes defined in Greenlee (1981).

3 Seasonal means for more than 1 month.

4 Reflects ability of soil to retard movement of landfill from the landfills; may not be a limitation in arid and semiarid areas. Soil permeability classes defined in Greenlee (1981).

5 Reflects the ease of digging and moving soil material (workability) and trafficability in the immediate area of the trench that may not have surface roads. Soil textural classes defined in Greenlee (1981).

6 Soils high in expansive clays may need to be given a limitation rating of severe.

7 Surface stoniness classes outlined in Greenlee (1981).

8 Rockiness classes are defined in The Canadian System of Soil Classification (Canada Soil Survey Committee, 1978).

9 Limitations only if a groundwater contamination hazard exists.

**Table 20.** Guide for developing soil interpretations for septic tank absorption fields

The septic tank absorption field is a subsurface tile system laid out in such a way that effluent from the septic tank is distributed with reasonable uniformity into the natural soil. When the effluent is percolated into the ground, the contained impurities are attacked by a myriad of biological organisms, naturally present in the soil (Alberta Manpower and Labour, 1972).

Absorption fields are influenced by the ease of downward movement of effluent through the soil. This guide provides ratings for undisturbed soils that are evaluated on their ability to absorb and filter the liquid or effluent passed through the tile field. Soils with slow permeability are rated severe. Clean sands and gravels with rapid permeability have slight limitations, unless a hazard exists for contaminating nearby water supplies. A rating of severe does not necessarily mean that a septic system should not be installed in a given soil, but rather suggests difficulty, in terms of installation and maintenance, can be expected.

**Soil limitation classes for septic tank absorption fields.**

| Properties affecting use | Degree of limitation | | | |
|---|---|---|---|---|
| | **None to Slight** | **Moderate** | **Severe** | **Very severe** |
| Flooding | None | None | Occasional (once in 5 years) | Floods every year |
| Wetness[1] (soil drainage class) | Very rapidly, rapidly and well-drained soils. Seasonal[2] WT >180 cm | Moderately well-drained soils - no seepage or ponding. Seasonal WT 120-180 cm | Moderately well-drained soils - occasional seepage or ponding. Seasonal WT 60-120 cm. Very rapidly and rapidly drained soils if groundwater contamination hazard | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils, permanently wet soils. Seasonal WT <60 cm |
| Slope | 0-9%(aA-dD) | >9-15% (eE) | >15-30% (fF) | >30% (gG, hH) |
| Permeability[3] | Very rapid to moderately rapid inclusive (>5.0 cm/hr) | Moderate (1.5-5.0 cm/hr) | Moderately slow and slow. (0 .15-1.5 cm/hr) Very rapid and rapid if groundwater contamination hazard (>15.0 c m/hr) | Very slow (<0.15 cm/hr) |
| Percolation Rate[4] (auger hole method) | About 8-18 min/cm | 18-24 min/cm | Slower than 24 min/cm | |
| Depth to bedrock[5] or other impervious material | >180 cm | 120-180 cm[6] | 60-120 cm | <60 cm |
| Depth to sand or gravel[5] | >180 cm | 120-180 cm[6,7] | 60-120 cm[7] | <60 cm[7] |

1 Water table depth based on the assumption that tile depth is 60 cm in the soil. Soil drainage classes defined in Greenlee (1981).

2 Seasonal means for more than one month. It may with caution be possible to make some adjustments for the severity of a water table limitation where seasonal use of the facility does not coincide with the period of high water table. A seasonal water table should be at least 120 cm below the bottom of the trench at all times for soils having a slight limitation (United States Department of Health, Education and Welfare, 1969). Where relief permits, the effective depth above a water table or rock can be increased by adding appropriate amounts of fill.

3 The limitation ratings should be based on the permeability of soil layers at and below the depth of the tile line. Soil permeability classes are defined in Greenlee (1981).

4 Soils having a percolation rate faster than about 8 min/cm are likely to present a pollution hazard to adjacent waters. This hazard must be noted, but the degree must be assessed in each case by examining the proximity of the proposed installation to water bodies, water table, and related features. Refer to Alberta Manpower and Labour, 1972 for details of the auger hole procedure.

5 Based on an assumed tile depth of 60 cm in the soil.

6 Where the slope is >9%, a depth to bedrock, sand or gravel of 120-180 cm is considered a severe limitation.

7 Limitation if a groundwater contamination hazard exists.

**Table 21.** Guides for assessing soil limitations for shallow excavating (urban services)

Shallow excavations are those that require excavating or trenching to a depth of 1 to 2 meters or less. Such uses include underground utility lines, *pipelines, sewers, cables, and open ditches*, although some supplemental criteria are needed to establish limitation ratings for pipelines. For example, additional interpretations about shrink-swell potential and corrosivity may be needed. Most of the anticipated uses involve backfilling, but some, such as open ditches, do not. Desirable soil qualities and characteristics are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops and big stones, and no flooding.

**Soil limitation classes for shallow excavations.**

| properties affecting Use | Degree of limitation | | |
|---|---|---|---|
| | **Slight** | **Moderate** | **Severe** |
| Wetness (soil drainage class) | Rapidly, very rapidly and well drained | Moderately well drained | Imperfectly, poorly, and very poorly drained |
| Seasonal water table | Below 150 cm | Between 75 and 150 cm | Above 75 cm |
| Flooding | None | None | Subject to flooding |
| Slope | 0 to 9% (aA-dD) | 9 to 15% (eE) | More than 15% |
| Texture of depth to be excavated[1,2] | FSL, SL, L, SiL, SiCL, SCL | Si[3], CL, SC, all gravelly types | C, SiC, S, LS, organic soils, all very gravelly types |
| Depth to bedrock[4] | More than 150 cm | 100 to 150 cm | Less than 150 cm |
| Surface stoniness (classes)[5] | 0, 1 | 2 | 3, 4, 5 |
| Rockiness (classes)[5] | 0 | 1 | Rock outcrops too frequent to permit shallow excavations |

1 Texture is used here as an index of workability and sidewall stability.
2 If soil contains a thick layer of material difficult (but not impossible) to excavate with handtools, increase the limitation rating by one class unless it already is severe.
3 If soil will stand in vertical cuts reduce rating to slight.
4 If bedrock is soft enough so that it can be dug out with ordinary handtools or light equipment, such as back hoes, reduce moderate and severe ratings by one class.
5 See definitions in Greenlee (1981).

**Table 22.** Guides for assessing soil limitations for pond reservoir areas and sewage lagoons

A reservoir or sewage lagoon requires consideration of the soil for two functions, (1) as a vessel for the impounded area, and (2) as soil material for a dam. Adequate soil material must be available that is suitable for the structure, and when properly constructed, the lagoon must be capable of holding water with minimum seepage. Soil requirements for basin floors of lagoons are (1) slow rate of seepage, (2) even surface of low relief and low gradient (for sewage lagoons) and (3) little or no organic matter. The materials for the basin floor should be so nearly impervious as to preclude the excessive loss of liquid and should be at least 1.2 meters thick.

**Soil limitation classes for lagoons.**

| Properties affecting use | Degree of limitation | | |
|---|---|---|---|
| | **Slight** | **Moderate** | **Severe** |
| Depth to water table | over 150 cm | 100 to 150 cm | Less than 100 cm |
| Permeability | <1.5 cm/hr | 1.5-5 cm/hr | >5 cm/hr |
| Depth to bedrock | More than 150 cm | 100 to 150 cm | Less than 100 cm |
| Slope | Less than 2% (aA, bB) | 2-9% (cC, dD) | Over 9% (eE) |
| Unified classification | GC, SC, CL, and CH | GM, ML, SM, and MH | GP, GW, SW, SP, OL, OH, and PT |
| Coarse fragments under 25 cm in diameter, by percent volume | Less than 20% | 20-50% | Over 50% |
| Organic matter | Less than 2% | 2-15% | Over 15% |
| Flooding hazard[1] | Not subject to flooding | Not subject to flooding | Subject to flooding |

[1] Applies to sewage lagoons but not to pond reservoir areas. Floodwaters interfere with the functioning of the lagoon and carry away sewage before bacterial decomposition has taken place.

**Table 23.** Guides for assessing soil susceptibility to water erosion

The evaluations of soil susceptibility to water erosion are based on the assumption that natural geologic water erosion is expected and accepted. Thus, the predicted erosion potential applies only when man's activities (including fires) cause a loss of vegetation on the soil surface which leads to accelerated erosion of that soil surface.

The soil ratings, K, (table 13) were estimated by the method of Wischmeier, Johnson and Cross (1971), (figure 1) and the slope angle ratings were adapted in part from Rutter (1968) (figure 2). The divisions on the graph are arbitrary, and are based on observations and published data.

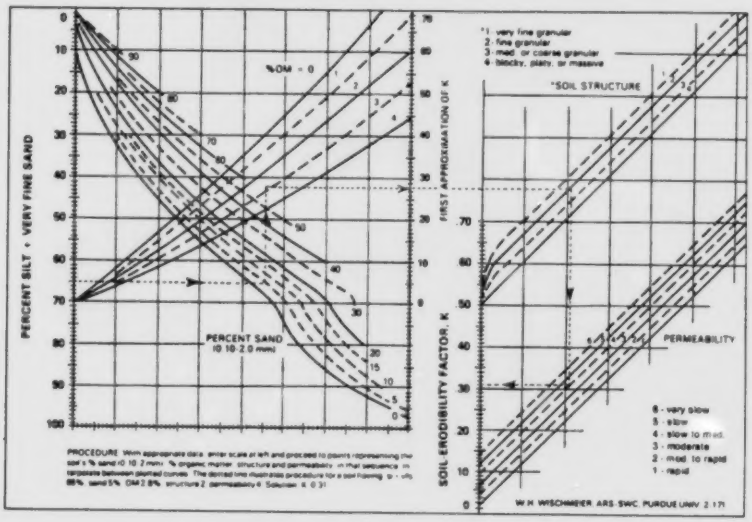
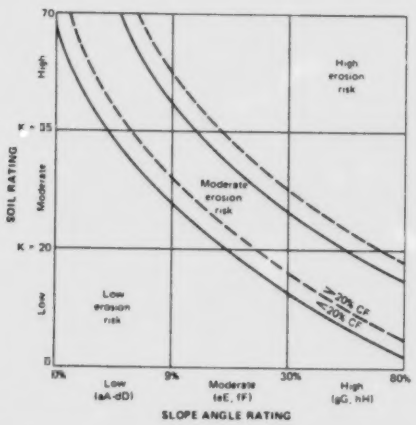



**Figure 1.** Soil-erodibility nomograph (taken from Wischmeier, Johnson, and Cross 1971).




Soils with >20 percent coarse fragments (CF>2 mm) are less susceptible to erosion and the band between the dashed lines indicates moderate erosion risk in such cases.

**Figure 2.** Erosion hazard of soils.

**Table 24.** Guide for developing soil interpretations for fully serviced campgrounds

This guide applies to soils to be used intensively for tents and camp trailers of various sizes; and the accompanying activities of outdoor living. A maximum of 17 to 25 sites per ha will be provided and camp sites will be gravelled or paved (personal communication with Mr. D. Perraton, Provincial Parks Division of Alberta Recreation and Parks). Modern sewage facilities will also be provided. The soil should be suitable for heavy foot traffic by humans, since natural areas will be left between campsites. Soil suitability for growing and maintaining vegetation is not a part of this guide, but is an important item to consider in the final evaluation of a site.

**Soil limitation classes for fully serviced campgrounds.**

| Properties affecting use | Degree of limitation | | | |
|---|---|---|---|---|
| | **None to Slight** | **Moderate** | **Severe** | **Very severe** |
| Flooding | None | Very occasional during season of use. Once in 5-10 years. | Occasional during season of use. Once in 2-4 years. | Flooding during every season of use |
| Wetness[1] (soil drainage class) | Very rapidly, rapidly, well and moderately well-drained soils - no seepage or ponding. WT >75 cm during season of use | Moderately well-drained soils - occasional seepage or ponding. Imperfectly drained soils - no seepage or ponding. WT >50 cm during season of use | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils. WT <50 cm during season of use | Permanently wet soils |
| Slope | 0-9% (aA-dD) | >9-15% (eE) | >15-30% (fF) | >30% (gG, hH) |
| Permeability[2] | Very rapid to moderate inclusive >1.5 cm/hr | Moderately slow and slow. 0.15-1.5 cm/hr | Very slow, <0.15 cm/hr | |
| Surface stoniness[3] | 0 and 1 | 2 | 3 and 4 | 5 |
| Rockiness[4] | No rock exposures | Rock exposures >25 m apart and cover <10% of the area | Rock exposures 10-25 m apart and cover 10-25% of the area | Rock exposures too frequent to permit campground location |
| Surface soil texture[5] | SL, FSL, VFSL, L and LS with textural B. Not subject to soil blowing | SiL, CL, SCL, SiCL, LS and sand other than loose sand | SC, SiC, C, SI | Sand subject to severe blowing. Organic soils |

1 Soil drainage classes defined in Greenlee (1981)
2 In low rainfall areas soils may be rated one class better. Soil permeability classes defined in Greenlee (1981).
3 Surface stoniness for the purpose of this table includes gravels and cobbles, or any coarse fragments >2 mm in diameter. Some gravelly soils may be rated none to slight when the gravel content exceeds 20% by only a small margin if a) the gravel is embedded in the soil matrix, or b) the fragments are <2 cm in diameter. Surface stoniness classes are defined in Greenlee (1981).
4 Very shallow soils are rated as severe for rockiness. Rockiness classes are defined in The Canadian System of Soil Classification (Canada Soil Survey Committee, 1978).
5 The soil textural classes are defined in Greenlee (1981).

**Table 25.** Guide for developing soil interpretations for picnic areas

This guide applies to soils considered for intensive use as park type picnic areas, which are subject to heavy foot traffic by humans. It is assumed that most vehicular traffic will be confined to access roads and parking areas (see table 17, Soil limitations for road location). Soil suitability for growing and maintaining vegetation is not a part of this guide, but is an important item to consider in the final evaluation of a site.

**Soil limitation classes for picnic areas.**

| Properties affecting use | Degree of limitation | | | |
|---|---|---|---|---|
| | **None to slight** | **Moderate** | **Severe** | **Very severe** |
| Flooding | None during season of use | May flood 1 or 2 times per year for short periods during season of use | Floods >2 times during season | Prolonged flooding during season of use |
| Wetness[1] (soil drainage class) | Very rapidly, rapidly, well and moderately well-drained soils - no seepage or ponding WT >50 cm during season of use | Moderately well-drained soils - occasional seepage or ponding. Imperfectly drained soils - no seepage or ponding. WT <50 cm for short periods during season of use | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils. WT <50 cm and often near surface for a month or more during season of use | Permanently wet soils |
| Slope | 0-9% (aA-dD) | >9-15% (eE) | >15-30% (fF) | >30% (gG, hH) |
| Permeability[2] | Very rapid to moderately slow inclusive (>0.5 cm/hr) | Slow and very slow (<0.5 cm/hr) | | |
| Surface stoniness[3] | 0, 1 and 2 | 3 | 4 | 5 |
| Rockiness[4] | Rock exposures >25 m apart and cover <10% of the area | Rock exposures 10-25 m apart and cover 10-25% of area | Rock exposures <10 m apart and cover >25% of the area | Rock exposures too frequent to permit location of picnic areas |
| Surface soil texture[5] | SL, FSL, VFSL, L and LS with textural B. Not subject to soil blowing | SiL, CL, SCL, SiCL, LS and sand other than loose sand | SC, SiC, C, Si | Loose sand subject to severe blowing. Organic soils. |

1 Soil drainage classes defined in Greenlee (1981).
2 In low rainfall areas, soils may be rated one class better. Restricted permeability is not considered a severe limitation for picnic areas. Soil permeability classes defined in Greenlee (1981).
3 Surface stoniness for the purpose of this table includes gravels and cobbles, or any coarse fragment >2 mm in diameter. Some gravelly soils may be rated none to slight when the content of gravel exceeds 20% by only a small margin if a) the gravel is embedded in the soil matrix, or b) the fragments are <2 cm in diameter. Surface stoniness classes defined in Greenlee (1981).
4 Very shallow soils rated as having a severe limitation for rockiness. The nature and topography of bedrock exposures may significantly alter these ratings. On site investigations may be needed. Rockiness classes are defined in The Canadian System of Soil Classification (Canada Soil Survey Committee, 1978).
5 The soil textural classes are defined in Greenlee (1981).

**Table 26.** Guide for developing soil interpretations for trails

This guide applies to soils to be used for primitive hiking trails. It is assumed that these areas will be used as they occur in nature, and that little or no soil will be moved (excavated or filled). It is also assumed that a dry stable tread is desirable and that muddy, dusty, worn, or eroded trail treads are undesirable. Hiking and riding trails are not treated separately, but as the design requirements for riding trails are more stringent, a given limitation will be more difficult to overcome. Only minimum preparation will be done, such as the clearing of trees and removal of a few boulders if necessary (personal communication with Mr. D. Perraton, Provincial Parks Division of Alberta Recreation and Parks). Soil features, such as surface texture and structure, that affect trafficability, dust, and design and maintenance of trails, should be given special emphasis.

**Soil limitation classes for trails.**

| Properties affecting use | Degree of limitation | | | |
|---|---|---|---|---|
| | **None to slight** | **Moderate** | **Severe** | **Very severe** |
| Flooding | None during season of use | May flood 1 or 2 times for short periods during season of use | Floods >2 times during season of | Prolonged flooding during season of use |
| Wetness[1] (soil drainage class) | Very rapidly, rapidly, well and moderately well-drained soils - no seepage or ponding. WT >50 cm during season of use | Moderately well-drained soils - occasional seepage or ponding. Imperfectly drained soils - no seepage or ponding. WT <50 cm for short periods during season of use | Imperfectly drained soils - seepage or ponding, poorly and very poorly drained soils. WT <50 cm and often near surface for a month or more during season of use | Permanently wet soils |
| Slope[2] | 0-15% (aA-eE) | >15-30% (fF) | >30-60% (gG) | >60% (hH) |
| Surface stoniness[3] | 0, 1 and 2 | 3 | 4 | 5 |
| Rockiness[4] | Rock exposures >25 m apart and cover <10% of the area | Rock exposures 10-25 m apart and cover 10-25% of the area | Rock exposures <10 m apart and cover >25% of the area | Rock exposures too frequent to permit location of trails |
| Surface soil texture[5] | SL, FSL, VFSL and L | SiL, SiCL, SCL, CL and LS | SC, SiC, C, Si and sand other than loose sand | Loose sand subject to severe blowing. Organic soils |

1 Soil drainage classes defined in Greenlee (1981)

2 Slope in this context refers to the slope of the ground surface, not the slope of the tread. Soil erodibility is closely related to slope. Some adjustments in slope range may be necessary in different climatic zones.

3 Surface stoniness for the purpose of this table includes gravels and cobbles, or any coarse fragments >2 mm in diameter. Gravels tend to cause unstable footing when present in high amounts, and are also associated with increased erosion. Cobbles and stones must be removed from the trail tread, increasing construction and maintenance of difficulties. Some gravelly soils may be rated none to slight when the content of gravel exceeds 20% by only a small margin if (a) the gravel is embedded in the soil matrix, or (b) the fragments are <2 cm in diameter. Surface stoniness classes are defined in Greenlee (1981).

4 Very shallow soils are rated as having a severe limitation for rockiness. The nature and topography of bedrock exposures may significantly alter these ratings. On site investigations may be necessary. Rockiness classes are defined in The Canadian System of Soil Classification (Canada Soil Survey Committee, 1978).

5 Texture refers to the soil texture which will form the tread texture. This is the surface texture on level areas, but may be a subsurface texture on slopes. The soil textural classes are defined in Greenlee (1981).

# References


Agriculture Canada (1976): Glossary of terms in soil science (Revised) Publ. 1459, Ottawa. 44 pages.

Arnold, R.W. (1979): Strategies for field resource inventories; Agronomy Mimeo 79-20, Department of Agronomy, Cornell University, Ithaca, New York, 14853.

Allan, J.A. (1943): General geology of Alberta, Alberta Research Council, Report 34l, 37 pages.

Borneuf, D. (1972): Hydrogeology of the Drumheller area, Alberta; Alberta Research Council Earth Sciences Report 72-1, 15 pages.

—— (1979): Hydrogeology of the Kananaskis Lakes area, Alberta; Alberta Research Council Earth Sciences Report 79-4, 13 pages.

Bostock, H.S. (1970): Physiographic subdivisions of Canada; *in* Geology and economic minerals of Canada, R.J.W. Douglas, (ed.); Geological Survey of Canada, Economic Geology Report No. 1, pp. 9-31.

Bowser, W.E. (1967): Agro-climatic areas of Alberta, scale 1:2 500 000; Survey and Mapping Branch, Department of Energy, Mines and Resources, Ottawa, Ontario.

Canada Land Inventory (1972): Soil capability classification for agriculture; Report No. 2; Environment Canada, Ottawa, Ontario.

Canada Soil Survey Committee, Subcommittee on Soil Classification (1978): The Canadian system of soil classification, Canada Department of Agriculture Publication 1646, Supply and Services Canada, Ottawa, Ontario. 164 pages.

Canada Soil Survey Committee, Working Group on Soil Survey Data (1978): The Canada soil information system (CanSIS), Manual for describing soils in the field (revised), Land Resource Research Institute, Canada Department of Agriculture, Ottawa, Ontario. J. Dumanski (ed.).

Canada Soil Survey Committee, Subcommittee on Methods of Analysis (1978): Manual on soil sampling and methods of analysis (2nd edition), Canadian Society of Soil Science, Ottawa, Ontario. J.A. McKeague (ed.).

Carrigy, M.A. (1971): Lithostratigraphy of the uppermost cretaceous (LANCE) and paleocene strata of the Alberta plains; Alberta Research Council Report 27, Edmonton, Alberta.

Clayton, J.S., W.A. Ehrlich, D.B. Cann, J.H. Day and I.B. Marshall (1977): Soils of Canada; The Canada Soil Survey Committee and The Soil Research Institute, Research Branch, Canada Department of Agriculture, Ottawa.

Coen, G.M., P.F. Epp, J. Tajek and L. Knapik (1977): Soil survey of Yoho National Park, Canada; Alberta Soil Survey Report No. 37, Agriculture Canada, Ottawa, Ontario.

Dawson, G.M. and R.G. McConnell (1895): Glacial deposits of southwestern Alberta in the vicinity of the Rocky Mountains; Bulletin of the Geological Society of America, v. 7, pp. 31 to 66.

Dokuchaev, V.V. (1889): On the theory of natural zones, Quoted by J.S. Joffe, in Pedology, 2nd edition, 1949.

Dumanski, J., T.M. Macyk, C.F. Veauvy and J.D. Lindsay (1972): Soil survey and land evaluation of the Hinton-Edson area, Alberta; Alberta Institute of Pedology Report No. S-72-31, Alberta Research Council, Edmonton, Alberta.

Eilers, R.G., L.A. Hopkins and R.E. Smith (1979): Soils of the Boissevain-Melita area; Canada-Manitoba Soil Survey, Report No. 20, Manitoba Department of Agriculture, Winnipeg, Manitoba.

Environment Canada. (n.d.) Monthly Record, meteorological observations in Canada.

Expert Committee on Soil Survey, Mapping Systems Working Group (1979): A proposed soil mapping system for Canada; Land Resource Research Institute, Canada Department of Agriculture, Ottawa, Ontario.

Fenton, M.M., S.R. Moran and D.N. Proudfoot (1981): Late quarternary stratigraphy and history of the Calgary, Alberta area; *in:* Calgary 1981, Volume 6, Geological Association of Canada, Mineralogical Association of Canada, Canadian Geophysical Union.

Gary, R., R. McAfee and C.L. Wolf (1972): Glossary of geology, American Geological Institute, Washington, D.C.

Green, R. (1972): Geological map of Alberta, scale 1:1 267 000; Alberta Research Council, Edmonton, Alberta.

Greenlee, G.M. (1981): Guidebook for use with soil survey reports of provincial parks and proposed park areas, Alberta Research Council Earth Sciences Report 81-1, 66 pages.

Glendenning, G.R. (1974): The glacial geomorphology of an area near Calgary, Alberta, between the Bow River and Fish Creek valleys, Calgary, Alberta; unpublished University of Calgary M.Sc. thesis.

Hopkins, J.W. (1938): Agricultural meteorology: Correlation of air temperature in central and southern Alberta and Saskatchewan with latitude, longitude and altitude; Canadian Journal of Research, v. 16, sec. 6.

Jackson, L.E. (1976): Quaternary stratigraphy and terrain inventory of the Alberta portion of the Kananaskis Lakes; unpublished University of Calgary Ph.D. thesis.

Macyk, T.M. (1972): Relief and microclimate as related to soil properties; unpublished University of Alberta M.Sc. thesis.

McBratney, A.B. (1984): Geostatistical soil survey. Unpublished Ph.D. thesis. University of Aberdeen, Scotland, U.K. 312 pages.

Meyboom, P. (1961): Groundwater resources of the City of Calgary and vicinity, Alberta Research Council Bulletin 8, 71 pages.

Miller, F.P., E. McCormack and J.R. Talbot (1979): Soil surveys: A review of data collection, methodologies, confidence limits and utilization, in Mechanics of track support, piles, and geotechnical data, Transportation Research Record 733, Commission on Sociotechnical Systems, National Academy of Sciences, Washington, D.C.

Moran, S.R. (1986): Urban geology of the Calgary area; Alberta Research Council Bulletin 53, 46 pages.

Morgan, A.V. (1966): Lithological and glacial geomorphological studies near the Erratics Train, Calgary area, Alberta; unpublished University of Calgary Ph.D. thesis.

Moss, E.H. (1955): The vegetation of Alberta; The Botanical Review, v. 21, pp. 493-567.

Nortcliff, S. (1978): Soil variability and reconnaissance soil mapping: A statistical study in Norfolk; J. of Soil Sci., Vol. 29, pp. 403-418.

Nowack, R.L. (1981): Pleistocene stratigraphy, City of Calgary; unpublished University of Calgary Ph.D. thesis.

Ozoray, G.F. and R. Barnes (1977): Hydrogeology of the Calgary-Golden area, Alberta; Alberta Research Council Earth Sciences Report 77-2, 38 pages.

Ozoray, G.F. and A.T. Lytviak (1974): Hydrogeology of the Gleichen area, Alberta; Alberta Research Council Earth Sciences Report 74-9, 16 pages.

Portland Cement Association (1962): PCA Soil Primer, Skokie, Illinois, U.S.A.

Proudfoot, D.N., S.R. Moran and N.W. Rutter (1981): The quaternary stratigraphy and geomorphology of southwest/central Alberta; *in:* Field guides to geology and mineral deposits, Calgary 1981, Calgary, Alberta: Geological Association of Canada, Mineralogical Association of Canada, Canadian Geophysical Union, R.F. Thompson and D.G. Cook (ed.).

Redmond, C.E., W.H. Brug, J.R. Vann and E.L. Millicon (1975): Soil survey of Richland County, Ohio; United States Department of Agriculture, Soil Conservation Service, Washington, D.C.

Roed, M.A. (1968): Surficial geology of the Edson-Hinton area, Alberta; unpublished University of Alberta Ph.D. thesis.

Rowe, J.S. (1959): Forest regions of Canada; Bulletin 123, Forestry Branch, Canadian Department of Northern Affairs and Natural Resources, Ottawa, Ontario.

Rutter, N.W. (1968): A method of predicting soil erosion in the Rocky Mountain forest reserve, Alberta; Geological Survey of Canada paper 67-67.

—— (1972): Geomorphology and multiple glaciation in the area of Banff, Alberta; Geological Survey of Canada Bulletin 206, Ottawa, Ontario.

Simonson, R.W. (1959): The outline of a generalized theory of soil genesis; Soil Science Society of America Proceedings, v. 23, pp. 152-156.

Stalker, A.M. (1956): The erratics train foothills of Alberta; Geological Survey of Canada Bulletin 37, Ottawa, Ontario.

Steers, C.A. and B.F. Hajek (1979): Determination of map unit composition by a random selection of transects; Soil Science Society of America Journal, v. 43, pp. 156-160.

Tharin, J.C. (1960): Glacial geology of the Calgary area; unpublished University of Calgary Ph.D. thesis.

Thwaites, F.T. (1963): Outline of glacial geology; 41 Roby Road, Madison 5, Wisconsin.

Toth, J. (1963): A theoretical analysis of groundwater flow in small drainage basins; Journal of Geophysical Research, v. 68, sec. 16, pp. 4795-4812.

Twardy, A.G. and I.G.W. Corns (1980): Soil survey and interpretations of the Wapiti map area, Alberta; Alberta Research Council Bulletin No. 39, 134 pages.

Water Survey of Canada 1981: Surface Water Data, Alberta 1980; Inland Waters Directorate, Water Resources Branch, Ottawa, Canada. 245 pages.

Wilken, E. (1979): Levels of ecological generalization proposed by the Canada Committee on Ecological (Bio-physical) Land Classification; *in:* A proposed soil mapping system for Canada, Expert Committee on Soil Survey, Mapping Systems Working Group, Land Resource Research Institute, Agriculture Canada, Ottawa, Ontario. K. Valentine (ed.).

United States Department of Agriculture (1972): Guide for interpreting engineering uses of soils; United States Department of Agriculture, Soil Conservation Service, Washington.

Wishmeier, W.H., C.B. Johnson and B.V. Cross (1971): A soil erodibility monograph for farmland and construction sites; Soil and Water Conservation, v. 26, pp. 189-193.

Wyatt, F.A., J.D. Newton, W.E. Bowser and W. Odynsky (1942): Soil survey of the Blackfoot and Calgary sheets; University of Alberta Bulletin No. 39, Edmonton, Alberta.

Wyatt, F.A., J.D. Newton, W.E. Bowser and W. Odynsky (1943): Soil Survey of the Rosebud and Banff sheets; University of Alberta Bulletin No. 40, Edmonton, Alberta.

Wilding, L.P. and L.R. Drees (1978): Spatial variability, A pedologist's viewpoint; *in:* Diversity of soils in the tropics. M. Shelly (ed). American Society of Agronomy, Soil Sci. Soc. Americ. Special Publication No.34, 119 pages.

# Appendix A. Descriptions, laboratory data and interpretations for pedons representative of soil series.

**Soil Series:** Academy **Series Symbol:** ADY **Sampled Soil Unit:** ADRK 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 2231 hectares 0.93% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Level to gently undulating morainal with silty aeolian veneer
**Drainage:** Well drained, no integrated drainage network
**Parent Material:** Fine silty till
**Comments:**

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 16 (¼ SEC) 22 (TWP) 1 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct 77

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 15 | 10YR 2/1 | loam | fine granular<br>medium prismatic | soft (dry) | clear<br>smooth | 1% |
| Bm | 43 | 10YR 3/3 | loam | moderate medium-<br>coarse prismatic | slightly hard<br>(dry) | clear<br>wavy | 1% |
| Cca | 90 | 10YR 7/2d<br>2.5Y 4/2m | loam | amorphous | loose (dry)<br>friable (moist) | diffuse<br>wavy | 1-2% |
| Ck | - | 10YR 7/2d<br>2.5Y 4/2m | silty<br>clay loam | amorphous | loose (dry)<br>friable (moist) | | |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | $\%CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.3 | .63 | 9.68 | 15 | - | .16 | 1.62 | 43.81 | 6.97 | 47.2 | 19 | 50 | 31 | SiCL-CL | |
| Bm | 6.9 | .19 | 2.37 | 12 | - | .06 | .67 | 25.66 | 7.74 | 25.6 | 17 | 53 | 30 | SiCL | |
| Cca | 7.5 | - | - | - | 27.6 | - | - | - | - | - | 15 | 46 | 39 | SiCL | |
| Ck | 8.1 | - | - | - | 24.2 | - | - | - | - | - | 11 | 50 | 39 | SiCL | |
| PM | | | | | | | | | | | | | | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 99 | 97 | 86 | 12 | 46 | 42 | 36 | 22 | 14 | 23 | 97.5 | SIC | CL | A6(10) |
| Ave. of 15 profiles | | | | | 28 | 47 | 25 | 32 | 20 | 12 | | | L | CL | A6 (9) |

# Appendix A. (continued)

## AGRICULTURAL INTERPRETATIONS

### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 1 | 2T | 3T | 4E<br>T | |

### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | 3002 | |
| Stubble | | | 2155 | |

## NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate (1.5-5 cm/hr) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Low-moderate (.20) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | Moderate (K = .32) | Slope range | 0.5 to 15% |
| Flooding hazard | Low | Slope stability | - |
| Frost heave potential | Moderate-high (F4) | Workability of material | Good-fair |

### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair | AH thickness, silty clay loam texture |
| Source of sand | Very poor | Silty clay loam texture |
| Source of gravel | Very poor | Silty clay loam texture |
| Source of roadfill | Fair | Silty clay loam texture |
| Road location | Moderate-severe | AASHO, frost heave potential |
| Permanent buildings | Moderate | Frost heave potential |
| Shallow excavations | Slight | No significant limitations |
| Septic tank absorption fields | Moderate | Moderate permeability |
| Sanitary landfills | Slight-moderate | Soil texture (L-SiCL) |
| Reservoir areas | Slight-moderate | Moderate permeability |
| Camp areas | Moderate | Surface soil texture (SiCL-CL) |
| Picnic areas | Moderate | Surface soil texture (SiCL-CL) |
| Paths and trails | Moderate | Surface soil texture (SiCL-CL) |

# Appendix A. (continued)

**Soil Series:** Antler **Series Symbol:** ATL **Sampled Soil Unit:** ATL 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 23 427 hectares 9.86% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Undulating to rolling morainal
**Drainage:** Well drained, dendritic surface features
**Parent Material:** Fine loamy till
**Comments:**

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 29 / ¼ SEC — 22 / TWP — 2 / R — W5 / M **Sampled by:** RM **Sample date:** Sept. 77

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 15 | 10YR 2/im | loam | weak fine granular | soft (dry) very friable (moist) | clear | tr |
| Bm | 45 | 10YR 4/3-4/4 m | loam + silty clay loam | moderate fine subangular blocky | hard (dry) firm-friable (moist) | clear smooth | 1% |
| Cca | 60 | 2.5Y 4/2 10YR 7/2d (lime) | silt loam | pseudo-platy | soft (dry) friable (moist) | diffuse smooth | 10% |
| Ck | | 2.5Y 4/2 10YR 7/2d (lime) | silt loam to silty clay loam | - | soft (dry) friable (moist) | - | 10% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 5.7 | .54 | 6.22 | 12 | - | .07 | .94 | 29.46 | 5.56 | 40.0 | 16 | 55 | 29 | SiCL | |
| Bm | 6.3 | .12 | 1.27 | 10 | - | .42 | .42 | 17.34 | 5.02 | 23.0 | 16 | 54 | 30 | | |
| Cca | 7.7 | - | - | - | 20.1 | - | - | - | - | - | 20 | 58 | 22 | | |
| Ck | 7.6 | - | - | - | 16.5 | - | - | - | - | - | 22 | 51 | 27 | | |
| PM | - | - | - | - | - | - | - | - | - | - | - | - | - | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 75 | 74 | 66 | 54 | 29 | 43 | 28 | 28 | 19 | 9 | 18 | 105.0 | CL-L | CL | A4 (4) |
| Ave. of 34 profiles | | | | | 17 | 51 | 31 | 36 | 22 | 13 | | | SiCL | CL | A6 (5) |

# Appendix A. (continued)

## AGRICULTURAL INTERPRETATIONS

### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 2C | 2C | 3T | 4T | 5T |

### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | 2431 | 2934 | |
| Stubble | | 2126 | 2230 | |

## NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair to good | Permeability-unaltered | Moderate (15-5 cm/hr) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate-low | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .25) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .57) | Slope range | 1-30% |
| Flooding hazard | Low | Slope stability | - |
| Frost heave potential | Moderate-high (F4) | Workability of material | Good-fair |

### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair | Ah thickness (15-25 cm) |
| Source of sand | Very poor | Silty clay loam texture |
| Source of gravel | Very poor | Silty clay loam texture |
| Source of roadfill | Fair | Moderate shrink-swell, frost heave |
| Road location | Moderate | Moderate shrink-swell, frost heave |
| Permanent buildings | Moderate | Frost heave |
| Shallow excavations | Slight | No significant limitations |
| Septic tank absorption fields | Moderate | Moderate permeability |
| Sanitary landfills | Slight-moderate | Soil texture (L-SiCL) |
| Reservoir areas | Moderate | Moderate permeability |
| Camp areas | Moderate | Surface soil texture |
| Picnic areas | Moderate | Surface soil texture |
| Paths and trails | Moderate | Surface soil texture |

# Appendix A. (continued)

**Soil Series:** Balzac **Series Symbol:** BZC **Sampled Soil Unit:** BZC 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 8331 hectares 3.50% of total area
**Classification:** Saline Rego Humic Gleysol (CSSC 78) Salic Typic Aquoll (soil taxonomy)
**Landforms:** Level to depressional lacustrine blanket over till
**Drainage:** Poorly drained
**Parent Material:** Fine loamy to fine clayey recent lacustrine
**Comments:** Typical saline slough profile

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 10 (¼ SEC) 24 (TWP) 28 (R) W4 (M) **Sampled by:** RM **Sample date:** Aug. 1979

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah1 | 11 | 10YR 3/2d | loam | strong fine granular | soft (dry) very friable (moist) | abrupt smooth | 0 |
| Ah2 | 21 | 10YR 3/1d | clay loam | strong coarse granular to blocky | hard (dry) | clear smooth | 0 |
| Ahsk | 32 | 10YR 3/1d | clay loam - clay | strong fine blocky weak medium prismatic | firm | clear smooth | 0 |
| Csak | 48 | 10YR 4/1- 10YR 5/1 10YR 8/1 (rosettes) | clay | massive | very firm | gradual smooth | 0 |
| Csakg | - | 10YR 5/1 peds 10YR 5/6 mottles | clay loam - clay | massive | firm | | 0 |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah 1 | 7.2 | .59 | 5.39 | 9 | - | 3.92 | 2.32 | 27.28 | 9.68 | 31.8 | 22 | 43 | 35 | CL | |
| Ah 2 | 7.6 | .41 | 4.23 | 0 | .13 | 10.6 | 2.08 | 21.56 | 13.01 | 30.3 | 27 | 39 | 34 | CL | |
| Ahsk | 8.2 | .11 | 1.32 | 12 | 5.54 | 15.1 | 2.17 | 47.19 | 15.83 | 20.3 | 26 | 32 | 42 | C | |
| Csak | 8.4 | - | - | - | 15.71 | - | - | - | - | - | 29 | 34 | 37 | CL | |
| Csakg | 8.4 | - | - | - | 15.28 | - | - | - | - | - | 23 | 47 | 30 | CL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 99 | 99 | 96 | 79 | 20 | 43 | 37 | 35 | 17 | 18 | 16.5 | 110.0 | CL-SiCL | CL | A6 (11) |
| Ave. of 2 profiles | | | | | 21 | 52 | 26 | 35 | 17 | 18 | | | SiL | CL | A6 (11) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | 5N<br>W | 5N<br>W | 5N<br>W | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | 1878 | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair | Permeability-unaltered | Slow (.15-.5 cm/hr) |
| Compressibility | Moderate-high | Permeability-compacted | Low |
| Corrosion potential | High | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .25) | Shrink-swell potential | Moderate-high |
| Erodibility-subsoil | High (K = .40) | Slope range | 0-3% |
| Flooding hazard | High, frequent flooding | Slope stability | N.A. |
| Frost heave potential | High (F4) | Workability of material | Poor |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Salinity, flooding, wetness |
| Source of sand | Very poor | Clay loam texture, permanently wet |
| Source of gravel | Very poor | Clay loam texture, permanently wet |
| Source of roadfill | Very poor | Permanently wet |
| Road location | Very poor | Permanently wet |
| Permanent buildings | Very severe | Permanently wet, sulfate corrosion |
| Shallow excavations | Severe | Poorly drained, subject to flooding |
| Septic tank absorption fields | Very severe | Permanently wet, flooding, slow permeability |
| Sanitary landfills | Very severe | Permanently wet |
| Reservoir areas | Severe | Depth to water table, flooding |
| Camp areas | Very severe | Permanently wet soils |
| Picnic areas | Very severe | Permanently wet soils |
| Paths and trails | Very severe | Permanently wet soils |

# Appendix A. (continued)

**Soil Series:** Bearspaw (taxadjunct) **Series Symbol:** no series symbol **Sampled Soil Unit:** LLK 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1954 hectares 0.82% of total area
**Classification:** Calcareous Black, eroded phase (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Undulating to gently rolling glaciolacustrine
**Drainage:** Well drained, dendritic surface pattern
**Parent Material:** Fine silty to fine clayey glaciolacustrine
**Comments:**

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 9 (¼ SEC) 22 (TWP) 2 (R) W5 (M) **Sampled by:** RM **Sample date:** June 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahk | 6 | 10YR 2/1m | silty clay loam | moderate fine granular | very friable (moist) | clear smooth | 0 |
| Bmk | 22 | 10YR 3/3m to 10YR 4/4d | silty clay loam | moderate medium prismatic | slightly hard (dry) | gradual smooth | 0 |
| Ck | | 10YR 5/4m | silty clay loam | amorphous | loose to hard (dry) friable (moist) | | |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahk | 7.7 | 0.43 | 7.88 | 18 | | | | | | | 15 | 50 | 35 | SiCL | |
| Bmk | 7.8 | 0.31 | 8.74 | | | 0.04 | 1.14 | 52.11 | 4.77 | 20.8 | 15 | 50 | 35 | SiCL | |
| Ck | 8.2 | | | | 27.5 | | | | | | 11 | 49 | 40 | SiCL-SiC | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 100 | 100 | 90 | 9 | 49 | 42 | 44 | 24 | 20 | 25 | 95.0 | SiC | CL | A-7-6 (13) |
| Ave. of 11 profiles | | | | | 11 | 56 | 32 | 36 | 24 | 12 | | | SiCL | CL | A-7-6 (9) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 3E | 3E | 4T<br>E | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate slow (.5-1.5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate-low | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .31) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | Moderate-high (K = .35) | Slope range | 2-15% |
| Flooding hazard | - | Slope stability | Susceptible to failure |
| Frost heave potential | Moderate-high (F3) | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thin Ah (8-15 cm) |
| Source of sand | Very poor | Silty clay loam texture |
| Source of gravel | Very poor | Silty clay loam texture |
| Source of roadfill | Fair | Potential frost action |
| Road location | Severe | AASHO, frost heave, shrink-swell |
| Permanent buildings | Moderate | Shrink-swell, frost heave |
| Shallow excavations | Slight | No significant limitations |
| Septic tank absorption fields | Moderate | Moderately slow permeability |
| Sanitary landfills | Moderate | Silty clay loam texture |
| Reservoir areas | Slight | No significant limitations |
| Camp areas | Moderate | Surface soil texture (SiCL) |
| Picnic areas | Moderate | Surface soil texture (SiCL) |
| Paths and trails | Moderate | Surface soil texture (SiCL) |

# Appendix A. (continued)

**Soil Series:** Beddington **Series Symbol:** BED **Sampled Soil Unit:** DEL 4

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 2136 hectares, 0.89% of total area
**Classification:** Black Solodized Solonetz (CSSC 78) Typic Natriboroll (soil taxonomy)
**Landforms:** Undulating morainal
**Drainage:** Well to moderately well drained
**Parent Material:** Fine loamy to fine silty till
**Comments:** Small occurrence of Beddington soil in DEL 4 soil unit

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 31 / ¼ SEC — 26 / TWP — 28 / R — W4 / M **Sampled by:** RM **Sample date:** Aug. 1979

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 9 | 10YR 3/2d<br>10YR 2/1m | L | strong fine granular | very friable (moist)<br>soft (dry) | abrupt<br>smooth | 0 |
| Ae | 15 | 10YR 4/1m<br>10YR 5/1d | L | strong-moderate medium prismatic | slightly hard (dry)<br>very friable (moist) | abrupt<br>smooth | 0 |
| Bnt | 30 | 10YR 2/1d (stains)<br>10YR 3/2-3/3 (peds) | CL-C | strong medium - coarse columnar and medium blocky | very hard (dry) | clear<br>smooth | 1% |
| Ccasa | 60 | 10YR 6/3m<br>10YR 8/1d | CL | moderate coarse prismatic | slightly hard (dry) | gradual<br>smooth | 2% |
| Csk2 | 80 | 10YR 4/2m<br>10YR 5/3d | CL | - | firm (moist) | - | 2% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.7 | .66 | 7.27 | 11 | - | .44 | 1.06 | 30.63 | 5.33 | 34.8 | 28 | 47 | 25 | CL-L | |
| Ae | 6.2 | .26 | 3.33 | 13 | - | 2.1 | .41 | 9.53 | 3.18 | 14.5 | 47 | 40 | 13 | L | |
| Bnt | 8.6 | .19 | 1.82 | 10 | 5.54 | 14.42 | 1.04 | 30.94 | 11.99 | 19.5 | 41 | 31 | 28 | L-CL | |
| Ccasa | 9.4 | - | - | - | 29.72 | - | - | - | - | - | 20 | 53 | 27 | SiCL-CL-SiL | |
| Csk2 | 8.5 | - | - | - | 14.06 | - | - | - | - | 7 | 8 | - | - | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 90 | 90 | 85 | 62 | 29 | 36 | 35 | 32 | 16 | 16 | 15 | 112.5 | CL | CL | A6 (7) |
| Ave. of 3 profiles | | | | | 16 | 57 | 27 | 32 | 16 | 16 | | | SiL-SiCL | CL | A6 (7) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 3D | 3D<br>T | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate slow (.5-1.5 cm/hr) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .30) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .54) | Slope range | .5 to 9% |
| Flooding hazard | Low | Slope stability | - |
| Frost heave potential | Moderate (F3) | Workability of material | Fair-good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thin Ah |
| Source of sand | Very poor | Silty clay loam texture |
| Source of gravel | Very poor | Silty clay loam texture |
| Source of roadfill | Fair-poor | Moderate shrink-swell |
| Road location | Moderate-severe | Moderate shrink-swell |
| Permanent buildings | Moderate | Frost heave, sulfate attack, shrink-swell |
| Shallow excavations | Moderate | Seasonally high water table |
| Septic tank absorption fields | Severe | Moderate slow permeability |
| Sanitary landfills | Moderate | Clay loam - silty clay loam texture |
| Reservoir areas | Slight-moderate | Seasonally high water table |
| Camp areas | Moderate | Permeability, surface texture |
| Picnic areas | Moderate | Seasonally high water table |
| Paths and trails | Moderate | Surface texture, seasonally high water table |

# Appendix A. (continued)

**Soil Series:** Bow Valley **Series Symbol:** BOV **Sampled Soil Unit:** BOV 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1923 hectares, 0.80% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Glaciofluvial delta; level to undulating
**Drainage:** Rapid
**Parent Material:** Loamy skeletal glaciofluvial
**Comments:** No engineering sample taken

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 1 (¼ SEC) 21 (TWP) 1 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 14 | 10YR 2/1m<br>10YR 3/1d | loam | weak, fine granular<br>moderate medium<br>- coarse prismatic | soft (dry)<br>very friable<br>(moist) | abrupt<br>smooth | 1% |
| Bm | 25 | 10YR 4/4m<br>10YR 4/6d | sandy loam | moderate medium-<br>coarse prismatic | slightly hard (dry)<br>very friable<br>(moist) | abrupt<br>smooth | 1% |
| Ck | | 10YR 7/2d<br>10YR 5/2m | gravel | single grain | loose (dry) | | 90% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | $\%CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.4 | .29 | 3.9 | 13 | - | - | - | - | - | - | 36 | 47 | 17 | L | |
| Bm | 7.3 | .12 | 1.50 | 13 | - | - | - | - | - | - | 31 | 49 | 20 | L-SiL | |
| Ck | 7.6 | - | - | - | 20.3 | - | - | - | - | - | - | - | - | - | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 4M<br>P | 4M<br>P | - | 6T<br>P | - |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Rapid (15-50 cm/hr) |
| Compressibility | Low | Permeability-compacted | High |
| Corrosion potential | Low | Shear strength | High |
| Erodibility-topsoil | Moderate (K = .31) | Shrink-swell potential | Low |
| Erodibility-subsoil | Low | Slope range | 2 to 9% some 15-30% |
| Flooding hazard | Infrequent | Slope stability | NA |
| Frost heave potential | Low | Workability of material | Good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Surface stoniness, thin Ah horizon |
| Source of sand | Poor | High coarse fragment content |
| Source of gravel | Good-fair | Contains some fine particle size material |
| Source of roadfill | Good | No significant limitations |
| Road location | Slight | No significant limitations |
| Permanent buildings | Slight | No significant limitations |
| Shallow excavations | Severe | Gravelly soils |
| Septic tank absorption fields | Severe | Groundwater contamination hazard |
| Sanitary landfills | Severe | Groundwater contamination hazard |
| Reservoir areas | Severe | Rapid permeability, high coarse fragments |
| Camp areas | Moderate | Surface stoniness |
| Picnic areas | Moderate | Surface stoniness |
| Paths and trails | Moderate | Surface stoniness, surface texture |

# Appendix A. (continued)

**Soil Series:** Bragg Creek **Series Symbol:** BRG **Sampled Soil Unit:** BRG 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 58 hectares, 0.02% of total area
**Classification:** Eluviated Eutric Brunisol (CSSC 78) Typic Eutrochrept (soil taxonomy)
**Landforms:** Glaciofluvial terrace
**Drainage:** Rapidly drained, central drainage channel
**Parent Material:** Loamy skeletal glaciofluvial
**Comments:** Taxadjunct to Bragg Creek, clay accumulation horizon

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 35 (¼ SEC) 22 (TWP) 5 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| LH | +2 - 0 | | leaf litter | - | - | - | - |
| Ae | 10 | 10YR 5/3 to 6/3d | loamy fine sand | moderate fine platy | loose - soft (dry) | clear wavy | 2% |
| Bm1 | 20 | 7.5YR 4/4m | fine sandy loam - loamy fine sand | single grain | loose (dry) | gradual wavy | 2% |
| Bm2 | 80 | 5YR 3/3m | loam and gravel | single grain | loose (dry) | clear wavy | 70% |
| Ck | - | 10YR 3/2 to 3/3m | sand and gravel | single grain | loose (dry) | - | 70% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | 7.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| Ae | 6.6 | .05 | 1.25 | 25 | - | .04 | .19 | 10.47 | 2.05 | 10.8 | 27 | 63 | 10 | SiL | |
| Bm1 | 5.3 | .06 | 1.17 | 20 | - | .07 | .19 | 7.94 | 2.82 | 16.3 | 29 | 55 | 16 | SiL | |
| Bm2 | 7.0 | .08 | 2.50 | - | - | 3.73 | .59 | 28.31 | 9.78 | 23.6 | 30 | 32 | 38 | CL | |
| Ck | 7.4 | - | - | - | 21.8 | - | - | - | - | - | 43 | 40 | 17 | L | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 59 | 45 | 26 | 12 | 59 | 25 | 16 | 25 | 20 | 5 | 19 | 105.0 | SL | GP-GC | A-1a(0) |
| Ave. of 2 profiles | | | | | 43 | 40 | 17 | 25 | 20 | 5 | | | L | GP-GC | A-1a(0) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 5C | 5C | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Rapid (15-50 cm/hr) |
| Compressibility | Low | Permeability-compacted | High |
| Corrosion potential | Low | Shear strength | High |
| Erodibility-topsoil | High (K = .51) | Shrink-swell potential | Low |
| Erodibility-subsoil | Moderate (K = .37) | Slope range | .5 to 5% |
| Flooding hazard | Occasional flooding | Slope stability | Stable |
| Frost heave potential | Low (F1) | Workability of material | Good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Very poor | < 8 cm Ah, surface stoniness |
| Source of sand | Poor | High coarse fragment content |
| Source of gravel | Good-fair | Seasonal water table |
| Source of roadfill | Good-fair | Seasonal water table |
| Road location | Moderate | Seasonal water table, infrequent flooding |
| Permanent buildings | Severe | Occasional flooding |
| Shallow excavations | Severe | Gravelly soils, seasonally high water table |
| Septic tank absorption fields | Severe | Groundwater contamination hazard |
| Sanitary landfills | Severe | Groundwater contamination hazard |
| Reservoir areas | Severe | Rapid permeability, high coarse fragment content |
| Camp areas | Severe | Surface stoniness, surface texture |
| Picnic areas | Moderate | Surface stoniness, surface texture |
| Paths and trails | Moderate | Surface stoniness, surface texture |

# Appendix A. (continued)

**Soil Series:** Connop **Series Symbol:** CON **Sampled Soil Unit:** CON 1 (ELRS 4)

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 57 hectares, 0.02% of total area
**Classification:** Eluviated Eutric Brunisol (CSSC 78) Typic Eutrochrept (soil taxonomy)
**Landforms:** Level to undulating glaciofluvial
**Drainage:** Rapidly drained, few surface drainage features
**Parent Material:** Sandy to coarse loamy glaciofluvial
**Comments:** Sand grains appear to be composed of calcite and dolomite

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 34 / ¼ SEC — 22 / TWP — 5 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| LH | +3 - 0 | - | leaf litter | - | - | - | - |
| Ae | 10 | 5YR 6/4d<br>5YR 4/4m | loamy sand | weak, fine platy | slightly hard (dry)<br>very friable (moist) | clear<br>smooth | 3% |
| Bm | 25 | 5YR 4/4m | sandy loam | amorphous | very friable to friable (moist) | abrupt<br>wavy | 3% |
| Ckg | - | 2.5YR 4/2 | sand to fine sand | single grain | loose (dry) non-sticky, nonplastic wet | - | 0% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | 5.2 | - | 38.43 | - | - | - | - | - | - | - | - | - | - | - | |
| Ae | 5.3 | .06 | 1.14 | 19 | - | .02 | .31 | 10.06 | 1.64 | 12.2 | 41 | 46 | 13 | L | |
| Bm | 5.1 | .04 | 0.61 | 15 | - | 2.75 | .23 | 11.69 | 1.23 | 13.9 | 41 | 39 | 20 | L | |
| Ckg | 7.1 | - | - | - | 60.2 | - | - | - | - | - | 64 | 29 | 7 | SL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 85 | 81 | 66 | 3 | 87 | 7 | 6 | NA | NA | non-plastic | | | LS-S | SW-SC | A3 (0) |
| Ave. of 3 profiles | 94 | 91 | 82 | 32 | 49 | 36 | 15 | 25 | 19 | 6 | 18 | 105.5 | L | SM(d) | A-2-4 (0) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 5C | 5C | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good-fair | Permeability-unaltered | Rapid (15-50) |
| Compressibility | Low-moderate | Permeability-compacted | High-moderate |
| Corrosion potential | Low-moderate | Shear strength | High-moderate |
| Erodibility-topsoil | Moderate (K = .36) | Shrink-swell potential | Low |
| Erodibility-subsoil | Moderate (K = .28) | Slope range | .5 - 9% |
| Flooding hazard | Low | Slope stability | - |
| Frost heave potential | Low-moderate | Workability of material | Good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Very poor | No Ah horizon |
| Source of sand | Fair | Depth to sand and gravel included fines |
| Source of gravel | Poor | Sandy texture |
| Source of roadfill | Good | Shrink-swell, frost hazard |
| Road location | Slight | Shrink-swell, frost hazard |
| Permanent buildings | Slight-moderate | Frost hazard, shrink-swell |
| Shallow excavations | Severe | Texture(s) |
| Septic tank absorption fields | Slight | Rapid permeability |
| Sanitary landfills | Severe | Texture(s), rapid permeability |
| Reservoir areas | Severe | Unified soil group (SW), permeability |
| Camp areas | Slight-moderate | Silt loam surface texture |
| Picnic areas | Slight-moderate | Silt loam surface texture |
| Paths and trails | Slight-moderate | Silt loam surface texture |

# Appendix A. (continued)

**Soil Series:** Delacour **Series Symbol:** DEL **Sampled Soil Unit:** DEL 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 53935 hectares, 22.67% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Undulating to gently rolling morainal
**Drainage:** Well drained, integrated
**Parent Material:** Fine loamy till
**Comments:** Sampled at soil climate recording site.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 10 (¼ SEC) 24 (TWP) 28 (R) WR (M) **Sampled by:** RM **Sample date:** June 1979

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| F | +-0 | 10YR 3/3d | fibrous grass roots | - | - | clear smooth | 0 |
| Ap | 20 | 10YR 2/1m 10YR 3/2d | loam | strong fine-medium granular | very friable (moist) soft (dry) | abrupt smooth | 0 |
| Bm1 | 35 | 10YR 3/3m (ped surface) 10YR 4/3m (ped interior) | clay loam | strong medium-coarse prismatic and moderate fine subangular blocky | friable (moist) | abrupt smooth | 1-2% |
| Bm2 | 50 | 2.5Y 4/2m 10YR 6/2d | clay loam | amorphous | friable (moist) slightly hard (dry) | diffuse smooth | 2-5% |
| Cca | 75 | 2.5Y 4/2m | clay loam | amorphous | friable (moist) slightly hard (dry) | - | 3-5% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | 5.6 | - | 21.56 | - | - | - | - | - | - | - | - | - | - | SiL | |
| Ab | 5.7 | .37 | 5.49 | 15 | - | .08 | 3.89 | 14.81 | 4.62 | 16.5 | 24 | 52 | 24 | SiL | |
| Bm1 | 5.6 | .12 | 1.30 | 11 | - | .05 | 2.15 | 9.78 | 4.51 | 12.7 | 31 | 36 | 33 | CL | |
| Bm2 | 6.1 | .09 | 1.10 | 12 | - | .07 | 1.24 | 10.22 | 3.95 | 8.7 | 32 | 37 | 31 | CL | |
| Cca | 7.5 | - | - | - | 11.48 | - | - | - | - | - | 33 | 39 | 28 | L-CL | |
| Ck | 7.7 | - | - | - | 9.39 | - | - | - | - | - | - | - | - | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 95 | 95 | 91 | 63 | 36 | 34 | 30 | 34 | 19 | 15 | 18 | 105.0 | CL | CL | A6 (8) |
| Ave. of 21 profiles | - | - | - | - | 14 | 49 | 37 | 38 | 22 | 16 | | | SICL | CL | A6 (7) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | 1 | 1 | 2T | 3T<br>E | 4T<br>E | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | 2455 | 2578 | 2748 | 1321 |
| Stubble | 1913 | 1709 | 2069 | 1018 |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate (1.5 - 5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate |
| Erodibility-topsoil | Moderate (K = .25) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .40) | Slope range | 1 - 15% |
| Flooding hazard | - | Slope stability | - |
| Frost heave potential | Moderate (F3) | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair-good | Ah thickness < 25 cm |
| Source of sand | Very poor | Clay loam to loam texture |
| Source of gravel | Very poor | Clay loam to loam texture |
| Source of roadfill | Fair | Moderate shrink-swell, frost heave |
| Road location | Moderate | Shrink-swell, frost heave |
| Permanent buildings | Moderate | Shrink-swell, frost heave |
| Shallow excavations | Slight-moderate | Soil texture |
| Septic tank absorption fields | Moderate | Moderate permeability |
| Sanitary landfills | Slight-moderate | Soil texture |
| Reservoir areas | Moderate | Moderate permeability |
| Camp areas | Slight-moderate | Loam to silt loam surface texture |
| Picnic areas | Slight-moderate | Loam to silt loam surface texture |
| Paths and trails | Slight-moderate | Loam to silt loam surface texture |

# Appendix A. (continued)

**Soil Series:** DeWinton **Series Symbol:** DWT **Sampled Soil Unit:** DWT 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 2377 hectares, 0.99% of total area
**Classification:** Rego Humic Gleysol (CSSC 78) Calcic Aquoll (soil taxonomy)
**Landforms:** Level to depressional recent lacustrine
**Drainage:** Poorly drained, deranged - scattered depressions
**Parent Material:** Fine loamy to fine silty recent lacustrine
**Comments:** Typical non saline slough profile.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 26 / ¼ SEC — 21 / TWP — 1 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Om | 18 | 10YR 2/1 | loam | fine granular | very friable (moist) soft (dry) | clear smooth | 0 |
| Ahg | 27 | 5Y 2/1 | clay | moderate medium granular | very firm (moist) | abrupt smooth | <1% |
| Ckg | | 5Y 6/2 - 5/2 mottles 10YR 6/6 | silty clay loam - sandy clay loam | amorphous | friable - firm (moist) | | 3-5% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Om | 6.6 | 1.13 | 16.36 | 15 | - | 0.34 | 2.44 | 43.44 | 11.78 | 54.6 | 14 | 56 | 30 | SiCL | |
| Ahg | 7.4 | .20 | 2.70 | 14 | - | - | - | - | - | - | 16 | 52 | 32 | SiCL | |
| Ckg | 7.6 | - | - | - | 18.2 | - | - | - | - | - | 22 | 51 | 27 | SiL-CL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of 1 profiles | 84 | 79 | 72 | | 20 | 50 | 30 | 30 | 19 | 11 | 18 | 105.0 | CL | CL-SC | A6 (4) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | 4W | 4W | | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair | Permeability-unaltered | Moderate (1.5 - 5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .28) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .52) | Slope range | 0 - 5% |
| Flooding hazard | High (frequent) | Slope stability | NA |
| Frost heave potential | Moderate-high | Workability of material | Fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Frequent flooding, poorly drained |
| Source of sand | Very poor | Silt loam to clay loam texture |
| Source of gravel | Very poor | Silt loam to clay loam texture |
| Source of roadfill | Severe | Frequent flooding, high water table |
| Road location | Very severe | Flooding, seasonally high water table |
| Permanent buildings | Very severe | Frequent flooding |
| Shallow excavations | Severe | Poorly drained, high water table, flooding |
| Septic tank absorption fields | Very severe | Poorly drained, high water table, flooding |
| Sanitary landfills | Very severe | Frequent flooding, poorly drained, high water table |
| Reservoir areas | Severe | High water table, frequent flooding |
| Camp areas | Very severe | Frequent flooding, permanently wet soil |
| Picnic areas | Severe | Frequent flooding, poorly drained |
| Paths and trails | Severe | Poorly drained, frequent flooding |

## Appendix A. (continued)

**Soil Series:** Dunvargan **Series Symbol:** DVG **Sampled Soil Unit:** DVG 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 29672 hectares, 12.48% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Undulating to rolling morainal blanket over level rock
**Drainage:** Well drained, few surface drainage features
**Parent Material:** Fine loamy till
**Comments:** Sample taken at soil climate recording site.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 33 (¼ SEC) 21 (TWP) 2 (R) W5 (M) **Sampled by:** RM **Sample date:** Sept. 1979

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 29 | 10YR 2/1m<br>10YR 3/2d | loam | moderate medium granular weak medium coarse prismatic | slightly hard (dry) | clear wavy | 0 |
| Bm | 79 | 10YR 4/3d<br>10YR 5/3d | loam-clay loam | moderate fine-medium subangular blocky weak medium-coarse prismatic | hard (dry)<br>friable (moist) | abrupt smooth | 1% |
| Cca | 100 | 10YR 6/2d<br>2.5Y 5/2m | clay loam | massive (pseudo platy) | slightly hard (dry) | diffuse smooth | 5% |
| Ck | - | 10YR 5/3m | clay loam | massive | slightly hard (dry) | - | 5-10% |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.0 | 1.18 | 8.99 | 8 | - | .05 | 1.18 | 39.19 | 6.25 | 44.2 | 16 | 51 | 33 | SiCL | |
| Bm | 6.7 | .2 | 1.38 | 7 | - | .05 | .55 | 15.69 | 4.61 | 22.1 | 7 | 58 | 35 | SiCL | |
| Cca | 7.5 | - | - | - | 15.93 | - | - | - | - | - | 31 | 45 | 24 | L | 1.91 |
| Ck | 7.5 | - | - | - | 16.51 | - | - | - | - | - | - | - | - | - | 1.98 |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 89 | 87 | 83 | 63 | 26 | 45 | 29 | 34 | 21 | 13 | 21 | 100.0 | CL | CL | A6 (7) |
| Ave. of 21 profiles | | | | | 13 | 49 | 37 | 38 | 21 | 17 | | | SiCL | CL | A6 (8) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 3C | 3C | 4T | 5T | 6T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | 1967 | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate (1.5-5 cm/hr) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .26) | Shrink-swell potential | Moderate-high |
| Erodibility-subsoil | High (K = .45) | Slope range | 3 - 45% |
| Flooding hazard | - | Slope stability | Potentially unstable |
| Frost heave potential | Moderate (F3) | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair | Ah thickness, silty clay loam texture |
| Source of sand | Very poor | Silty clay loam texture |
| Source of gravel | Very poor | Silty clay loam texture |
| Source of roadfill | Poor-fair | High shrink-swell potential |
| Road location | Moderate-severe | High shrink-swell potential |
| Permanent buildings | Moderate | Shrink-swell potential |
| Shallow excavations | Moderate | Clay loam - silty clay texture |
| Septic tank absorption fields | Moderate | Moderate permeability |
| Sanitary landfills | Moderate-severe | Clay loam - silty clay texture |
| Reservoir areas | Moderate | Moderate permeability |
| Camp areas | Moderate | Silty clay loam surface texture |
| Picnic areas | Moderate | Silty clay loam surface texture |
| Paths and trails | Moderate | Silty clay loam surface texture |

# Appendix A. (continued)

**Soil Series:** Elbow (taxadjunct) **Series Symbol:** ELB **Sampled Soil Unit:** FSH 5

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:**
**Classification:** Dark Gray Luvisol (CSSC 78) Mollic Cryoboralf (soil taxonomy)
**Landforms:** Undulating glaciolacustrine
**Drainage:** Moderately well, deranged surface drainage
**Parent Material:** Fine to very fine clayey glaciolacustrine
**Comments:** Midway between Fish Creek and Elbow soils in appearance.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 34 / ¼ SEC — 21 / TWP — 3 / R — W5 / M **Sampled by:** RM **Sample date:** Aug. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 25 | 10YR 2/1 | loam | moderate fine granular | friable (moist) | gradual smooth | 0 |
| Ahe | 29 | 10YR 3/2(m)<br>10YR 4/2(D) | loam | weak fine platy | friable (moist) | gradual smooth | 0 |
| AB | 34 | 10YR 3/2(m)<br>10YR 5/1(D) | clay loam | moderate medium blocky | friable - firm (moist)<br>slightly hard (dry) | clear smooth | 0 |
| Bt1 | 40 | 2.5Y 3/2(m)<br>2.5Y 5/2(D) | clay | strong fine sub-angular blocky | hard (dry)<br>firm (moist) | gradual smooth | 0 |
| Bt2 | 70 | 2.5Y 3/2(m)<br>2.5Y 4/2(D) | clay | strong fine-medium subangular blocky | hard (dry)<br>firm (moist) | abrupt wavy | 0 |
| Ck | - | 2.5Y 4/1(m) | clay | amorphous | very firm (moist) | | 0 |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 5.0 | .56 | 7.31 | 13 | - | .09 | .60 | 22.41 | 6.88 | 44.7 | 6 | 43 | 51 | | |
| Ahe | 4.9 | .34 | 3.83 | 11 | - | .11 | .61 | 20.41 | 6.81 | 38.4 | 6 | 52 | 42 | | |
| AB | 5.0 | .14 | 1.65 | 12 | - | .44 | .55 | 16.41 | 7.58 | 31.3 | 5 | 49 | 46 | | |
| Bt1 | 5.4 | .10 | 1.31 | 13 | - | .41 | .65 | 19.06 | 9.63 | 32.5 | 4 | 43 | 53 | | |
| Bt2 | 6.7 | .08 | 1.11 | 14 | - | .44 | .62 | 23.34 | 11.68 | 35.4 | 3 | 49 | 48 | | |
| Ck | 7.6 | - | - | - | 16.7 | - | - | - | - | - | 3 | 51 | 46 | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 99 | 98 | 94 | 5 | 31 | 64 | 55 | 27 | 28 | 28 | 92.5 | HC | CH | A-7-6 (18) |
| Ave. of 3 profiles | | | | | 4 | 48 | 47 | 54 | 28 | 26 | | | SiC | MH-CH | A-7-6 (17) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 5C | 5C | 5C | 6T | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Poor | Permeability-unaltered | Very slow (< .15 cm/hr) |
| Compressibility | High | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Low |
| Erodibility-topsoil | Low (K = .19) | Shrink-swell potential | High |
| Erodibility-subsoil | Moderate (K = .28) | Slope range | 2 to 15% |
| Flooding hazard | Low | Slope stability | Potentially unstable |
| Frost heave potential | Moderate-high (F3-F4) | Workability of material | Poor |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Clay surface texture |
| Source of sand | Very poor | Clayey texture |
| Source of gravel | Very poor | Clayey texture |
| Source of roadfill | Poor | High shrink-swell and frost heave, AASHO |
| Road location | Severe | High shrink-swell, AASHO, frost hazard |
| Permanent buildings | Severe | High shrink-swell and frost action |
| Shallow excavations | Severe | Clay texture |
| Septic tank absorption fields | Very severe | Very slow permeability |
| Sanitary landfills | Very severe | Clay texture |
| Reservoir areas | Slight | No significant limitations |
| Camp areas | Severe | Very slow permeability, clay texture |
| Picnic areas | Moderate-severe | Very slow permeability, clay surface texture |
| Paths and trails | Severe | Clay surface texture |

# Appendix A. (continued)

**Soil Series:** Unnamed OGL in Elbow Robinson Units **Series Symbol:** **Sampled Soil Unit:** ELRS 2

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 4580 hectares, 1.91% of total area
**Classification:** Orthic Gray Luvisol (CSSC 78) Typic Cryoboralf (soil taxonomy)
**Landforms:** Glaciolacustrine veneer over morainal level
**Drainage:** Moderately well drained, dendritic surface pattern
**Parent Material:** Fine to very fine clayey glaciolacustrine
**Comments:** Sampled OGL instead of more numerous DGL.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 27 / ¼ SEC — 22 / TWP — 4 / R — W5 / M **Sampled by:** RM **Sample date:** Aug. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| LH | (3-0) | | | | | | |
| Ah | | | | | | | |
| Ae | 8 | 7.5YR 4/2 5/4 | loam | moderate medium platy stony coarse granular | very friable (moist) | | 0 |
| AB | | (thin continuous) | | | | | |
| Bt1 | 18 | 10YR 3/3(D) | clay | stony coarse blocky some fine blocky | very firm (moist) | | 0 |
| Bt2 | 45 | 10YR 3/3(D) | clay | weak moderate-coarse prismatic and weak fine medium sub-angular blocky | very firm (moist) | | 0 |
| Ck | - | 10YR 3/2 | clay | moderate fine sub-angular blocky to massive | very firm (moist) | | 0 |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LN | 6.3 | .92 | 23.35 | 25 | - | .14 | 2.70 | 57.29 | 10.08 | 66.8 | - | - | - | - | |
| Ah | | | | | | | | | | | | | | | |
| Ae | 5.3 | .18 | 2.35 | 13 | - | .02 | 1.11 | 13.41 | 2.97 | 20.9 | 4 | 60 | 36 | | |
| Bt1 | 6.3 | .13 | 1.41 | 11 | - | .04 | .92 | 15.78 | 5.07 | 31.5 | - | 34 | 66 | | |
| Bt2 | 5.4 | .09 | 1.31 | 15 | - | .41 | 1.05 | 29.06 | 7.94 | 38.6 | - | 23 | 77 | | |
| Ck | 7.4 | - | - | - | 22.9 | - | - | - | - | - | 2 | 40 | 58 | | |
| PM | - | - | - | - | - | - | - | - | - | - | - | - | - | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | - | - | - | 99 | 2 | 36 | 62 | 53 | 28 | 25 | 29 | 90.0 | HC | CH | A-7-6 (16) |
| Ave. of 4 profiles | | | | | 16 | 51 | 33 | 36 | 21 | 16 | | | SiCL | CL | A6 (10) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 5C | 5C | 5C | 6T | 6T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Poor | Permeability-unaltered | Slow-very slow (< .5) |
| Compressibility | High | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Low (K = .14) | Shrink-swell potential | High |
| Erodibility-subsoil | Moderate (K = .28) | Slope range | .5 - 100% |
| Flooding hazard | Low | Slope stability | Potentially unstable |
| Frost heave potential | Moderate | Workability of material | Poor |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Very poor | No Ah horizon |
| Source of sand | Very poor | Unified soil group (CH), clay texture |
| Source of gravel | Very poor | Unified soil group (CH), clay texture |
| Source of roadfill | Poor | Shrink-swell, potential frost heave |
| Road location | Poor | Shrink-swell, potential frost heave |
| Permanent buildings | Moderate-severe | Shrink-swell, potential frost heave |
| Shallow excavations | Moderate-severe | Soil drainage class texture (C) |
| Septic tank absorption fields | Severe | Slow permeability |
| Sanitary landfills | Moderate-severe | Texture (C), soil drainage class |
| Reservoir areas | Slight | No significant limitations |
| Camp areas | Moderate-severe | Soil drainage class, texture |
| Picnic areas | Moderate-severe | Soil drainage class, texture |
| Paths and trails | Slight-moderate | Soil drainage class |

# Appendix A. (continued)

**Soil Series:** Fish Creek **Series Symbol:** FSH **Sampled Soil Unit:** FSH 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 16335 hectares, 6.87% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Undulating to gently sloping glaciolacustrine
**Drainage:** Moderately well drained, dendritic surface drainage pattern
**Parent Material:** Fine to very fine clayey glaciolacustrine
**Comments:** Sampled in foothills valley. Good photo taken at this site.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 26 (¼ SEC) 21 (TWP) 4 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 23 | 10YR 2/1 | loam | fine granular | very friable (moist) | clear smooth | 0 |
| Bm | 60 | 2.5Y 4/1 to 4/2 | clay | strong fine-medium subangular blocky | very firm (moist) | abrupt wavy | 0 |
| Ck | - | 2.5Y 4/2 | clay | amorphous | very firm (moist) | | |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 5.6 | .69 | 7.83 | 11 | - | .12 | .72 | 31.43 | 11.78 | 50.9 | 3 | 39 | 58 | SiC | |
| Bm | 5.6 | .07 | .67 | 10 | - | .48 | .87 | 30.41 | 13.63 | 42.1 | - | 26 | 74 | HC | |
| Ck | 7.4 | - | - | - | 1.67 | - | - | - | - | - | - | 25 | 75 | HC | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 99 | 99 | 99 | 97 | 1 | 8 | 81 | 68 | 33 | 35 | <30 | >85.0 | HC | CH | A7-5 (20) |
| Ave. of 62 profiles | | | | | 5 | 37 | 58 | 50 | 25 | 25 | | | SiC-C | CH-CL | A7-6 (16) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 4S | 4S | 4S | 5(ST) | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | 2406 | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-poor | Permeability-unaltered | Very slow (< .15) |
| Compressibility | High | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Low-moderate |
| Erodibility-topsoil | Low (K = .16) | Shrink-swell potential | High |
| Erodibility-subsoil | Low (K = .20) | Slope range | .5 - 10% |
| Flooding hazard | Low | Slope stability | Potentially unstable |
| Frost heave potential | Moderate | Workability of material | Poor |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair-poor | Texture (SiC), thickness of Ah |
| Source of sand | Very poor | Unified soil group (CH), clay texture |
| Source of gravel | Very poor | Unified soil group (CH), clay texture |
| Source of roadfill | Poor | Shrink-swell, frost action |
| Road location | Moderate | Wetness, frost action, shrink-swell |
| Permanent buildings | Moderate-severe | Frost action, shrink-swell, wetness |
| Shallow excavations | Moderate-severe | Clay texture, soil drainage class |
| Septic tank absorption fields | Very severe | Slow permeability |
| Sanitary landfills | Moderate | Soil drainage class, clay texture |
| Reservoir areas | Slight | No significant limitations |
| Camp areas | Moderate-severe | Permeability, surface soil texture (SiC) |
| Picnic areas | Moderate | Soil drainage class, permeability, surface soil texture (SiC) |
| Paths and trails | Moderate | Soil drainage class |

## Appendix A. (continued)

**Soil Series:** Fish Creek (2) **Series Symbol:** FSH **Sampled Soil Unit:** FSH 3

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 16335 hectares, 6.87% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Glaciolacustrine veneer to blanket over undulating morainal
**Drainage:**
**Parent Material:** Fine clayey glaciolacustrine over fine loamy till
**Comments:** Example of glaciolacustrine Fish Creek soil overlying till at 150 cm

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 27 (¼ SEC) 24 (TWP) 3 (R) W5 (M) **Sampled by:** RM **Sample date:** May 1978

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 18 | 10YR 2/1m<br>10YR 3/2d | loam | moderate, medium to coarse, granular | friable, moist | clear wavy | 0 |
| Bm | 44 | 10YR 3/4m<br>10YR 3/3d | clay loam | weak, medium, prismatic | firm, moist | abrupt smooth | 0 |
| Cca | 100 | 2.5Y 5/2m<br>10YR 6/3d | clay | massive | very firm, moist | gradual smooth | 1-2% |
| Ck | 150 | 2.5Y 4/2m<br>10YR 6/3d | heavy clay | bedded | very firm, moist | abrupt wavy | 1-2% |
| IICk | | 2.5Y 4/2m<br>10YR 6/3d | clay loam | massive | very hard, dry<br>firm, moist | | 5-10% |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.1 | 0.54 | 6.51 | 12 | | 0.08 | 0.93 | 31.25 | 5.71 | 37.1 | 4 | 54 | 42 | | |
| Bm | 6.8 | 0.18 | 1.49 | 8 | | 0.08 | 0.45 | 21.97 | 6.76 | 26.0 | 2 | 58 | 40 | | |
| Cca | 7.8 | | | | 21.8 | | | | | | 6 | 55 | 39 | | |
| Ck | 8.0 | | | | 15.4 | | | | | 2 | | 43 | | 55 | |
| IICk | 8.0 | | | | 17.1 | | | | | | 14 | 51 | 35 | | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 99 | 99 | 99 | 80 | 27 | 33 | 40 | 42 | 25 | 17 | 26 | 92.5 | C | CL | A-7-6 (11) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 4S | 4S | 4S | 5(TS) | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | 2406 | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Very slow <.15 |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .22) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .45) | Slope range | 2 - 9% |
| Flooding hazard | Low | Slope stability | - |
| Frost heave potential | Moderate-high | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair | Thickness of Ah |
| Source of sand | Very poor | Unified soil group (CL), clay texture |
| Source of gravel | Very poor | Unified soil group (CL), clay texture |
| Source of roadfill | Fair-poor | Soil drainage class, frost action, shrink-swell |
| Road location | Fair-poor | Soil drainage class, frost action, shrink-swell |
| Permanent buildings | Moderate | Drainage class, shrink-swell, frost action |
| Shallow excavations | Moderate-severe | Drainage class, clay texture |
| Septic tank absorption fields | Very severe | Slow permeability |
| Sanitary landfills | Moderate-severe | Drainage class, clay texture |
| Reservoir areas | Slight | No significant limitations |
| Camp areas | Moderate | Drainage class, permeability |
| Picnic areas | Moderate | Drainage class, permeability |
| Paths and trails | Slight-moderate | Drainage class, surface texture (SiC) |

## Appendix A. (continued)

**Soil Series:** Happy Valley **Series Symbol:** HPV **Sampled Soil Unit:** HPV 2

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 3254 hectares, 1.33% of total area
**Classification:** Rego Black (CSSC 78) Entic Udic Haploboroll (soil taxonomy)
**Landforms:** Glaciofluvial blanket over till; inclined to rolling
**Drainage:** Rapidly drained, no surface features
**Parent Material:** Sandy to coarse loamy glaciofluvial
**Comments:**

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 24 / ¼ SEC — 21 / TWP — 29 / R — W4 / M **Sampled by:** RM **Sample date:** Nov. 1980

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Apkj | 14 | 10YR 3/2m | silt loam | single grain | very friable, moist | clear smooth | 0 |
| Ck | | 10YR 5/3m<br>10YR 7/2d | silt loam to loamy sand | single grain | very friable, moist<br>loose, dry | | 0 |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | $\%CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apkj | 7.4 | 0.13 | 3.63 | 28 | 13.22 | | | | | | 72 | 18 | 10 | | |
| Ck | 7.6 | | | | 32.35 | | | | | | 76 | 18 | 6 | | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 100 | 99 | 25 | 72 | 10 | 18 | NL | NP | NP | | | SL | SP-SC | A-2-4 (0) |
| Ave. of 5 profiles | | | | | 49 | 43 | 10 | | | | | | L | SP-SC | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 3M | 3(MT) | 4(MT) | 5(TM) | 6(TE) |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good-fair | Permeability-unaltered | Rapid (15 - 50) |
| Compressibility | Low-moderate | Permeability-compacted | High-moderate |
| Corrosion potential | Low-moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | High (K = .42) | Shrink-swell potential | Low |
| Erodibility-subsoil | High (K = .42) | Slope range | 5 - 45% |
| Flooding hazard | Low | Slope stability | |
| Frost heave potential | Low-moderate | Workability of material | Fair-good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thickness of Ah, presence of carbonates |
| Source of sand | Poor | Unified soil group (SP-SC) |
| Source of gravel | Very poor | Sandy loam to loamy sand texture |
| Source of roadfill | Good | No significant limitations |
| Road location | Good | No significant limitations |
| Permanent buildings | Slight | No significant limitations |
| Shallow excavations | Moderate-severe | Sandy loam to loamy sand texture |
| Septic tank absorption fields | Slight | Rapid permeability |
| Sanitary landfills | Severe-very severe | Rapid permeability, sandy texture |
| Reservoir areas | Severe | Rapid permeability |
| Camp areas | Slight-moderate | Sandy surface texture, subject to blowing |
| Picnic areas | Slight-moderate | Sandy surface texture, subject to blowing |
| Paths and trails | Slight-moderate | Sandy surface texture, subject to blowing |

# Appendix A. (continued)

**Soil Series:** Happy Valley (taxadjunct) **Series Symbol:** no series symbol **Sampled Soil Unit:** HPSC 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:**
**Classification:** Calcareous Black (CSSC 78) Haplic Udic Calciboroll (soil taxonomy)
**Landforms:** Glaciofluvial terrace
**Drainage:** Rapidly to very rapidly
**Parent Material:** Sandy to coarse loamy glaciofluvial with inclusions of gravel
**Comments:** Taxadjunct to Happy Valley, very similar but has Bmk horizon.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 33 (¼ SEC) 24 (TWP) 2 (R) W5 (M) **Sampled by:** RM **Sample date:** May 1978

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 10 | 10YR 2/2m<br>10YR 3/2d | sandy loam | single grain | loose (dry)<br>very friable (moist) | gradual<br>smooth | 0 |
| Bmk | 15 | 10YR 5/2d<br>10YR 4/3m | sandy loam | single grain | very friable (moist) | gradual<br>smooth | 0 |
| Cca | 28 | 10YR 7/2d<br>2.5Y 4/4m | sandy loam | single grain | very friable (moist) | gradual<br>smooth | 0 |
| Ck | - | 2.5Y 4/4m | sandy loam | single grain | very friable (moist) | - | 0 |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.6 | 0.48 | 6.00 | 13 | - | - | - | - | - | - | 52 | 31 | 17 | L-SL | |
| Bmk | 7.6 | 0.21 | 5.55 | | 31.1 | - | - | - | - | - | 52 | 34 | 14 | L-SL | |
| Cca | 7.8 | - | - | - | 39.0 | - | - | - | - | - | 41 | 45 | 14 | L | |
| Ck | 8.0 | - | - | - | 40.7 | - | - | - | - | - | - | - | - | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 100 | 99 | 34 | 55 | 39 | 16 | NL | NP | NP | | | SL | SC | A-2-4 (0) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 3M | 3M | 4(MT) | 5(TM) | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good-fair | Permeability-unaltered | Rapid (15 - 50) |
| Compressibility | Low-moderate | Permeability-compacted | Moderate-low |
| Corrosion potential | Low-moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .28) | Shrink-swell potential | Low |
| Erodibility-subsoil | High (K = .46) | Slope range | 5 - 45% |
| Flooding hazard | Low | Slope stability | |
| Frost heave potential | Low-moderate | Workability of material | Good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thickness of Ah, presence of carbonates |
| Source of sand | Poor | Unified soil group (SC) |
| Source of gravel | Very poor | Sandy loam texture |
| Source of roadfill | Good | Shrink-swell, AASHO |
| Road location | Slight-moderate | No significant limitations |
| Permanent buildings | Slight-moderate | No significant limitations |
| Shallow excavations | Slight-moderate | No significant limitations |
| Septic tank absorption fields | Slight-moderate | No significant limitations |
| Sanitary landfills | Severe | Rapid permeability, sandy texture |
| Reservoir areas | Severe | Rapid permeability, sandy texture |
| Camp areas | Moderate | Sandy surface texture, subject to blowing |
| Picnic areas | Moderate | Sandy surface texture, subject to blowing |
| Paths and trails | Moderate | Sandy surface texture, subject to blowing |

## Appendix A. (continued)

**Soil Series:** Indus **Series Symbol:** IND **Sampled Soil Unit:** DEL 6

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 2550 hectares, 1.06% of total area
**Classification:** Humic Luvic Gleysol (CSSC 78) Mollic Abaqualf (soil taxonomy)
**Landforms:** Level to depressional morainal
**Drainage:** Poorly drained, slow recharge into scattered depressions
**Parent Material:** Fine loamy to fine silty till, with thin veneer of recent lacustrine
**Comments:** Willow ringed epressions, silty texture near surface may be due to loess accumulation in depression.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 13 / ¼ SEC — 22 / TWP — 28 / R — W4 / M **Sampled by:** RM **Sample date:** Aug. 1980

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 17 | 10YR 2/1m<br>10YR 5/1d | loam to clay loam | moderate-strong fine granular | friable moist | gradual smooth | 0 |
| Aheg | 24 | 10YR 3/1m | silt loam fine platy | moderate-strong, | friable moist | clear wavy | 0 |
| Aeg1 | 33 | 10YR 5/1m<br>10YR 4/3m (mottles) | silt loam to very fine sandy loam | strong fine platy | very friable, moist | gradual smooth | 0 |
| Aeg2 | 48 | 10YR 4/1m<br>10YR 4/3m (mottles) | silt loam to silty clay loam | strong fine platy | friable, moist | clear smooth | 0 |
| Btg | 110 | 10YR 3.5/1m<br>10YR 3/3m (mottles) | clay loam | moderate-strong, fine subangular blocky | firm, moist sticky plastic, wet | clear smooth | 1% |
| Ckg | | 2.5Y 4/2m<br>10YR 4/4m | clay loam | massive | firm, moist | | 2% |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.1 | 0.31 | 4.74 | 15 | | 0.07 | 1.64 | 18.06 | 4.36 | 27.8 | 11 | 59 | 30 | | |
| Aheg | 6.2 | 0.12 | 1.71 | 14 | | 0.63 | 1.17 | 10.13 | 2.72 | 14.9 | 13 | 67 | 20 | | |
| Aeg1 | 6.3 | 0.05 | 0.62 | 12 | | 0.07 | 0.69 | 6.78 | 2.05 | 9.6 | 13 | 72 | 15 | | |
| Aeg2 | 6.3 | 0.05 | 0.53 | 10 | | 0.34 | 0.93 | 11.19 | 4.00 | 18.4 | 13 | 59 | 28 | | |
| Btg | 6.2 | 0.05 | 0.57 | 11 | | 0.33 | 0.92 | 14.41 | 6.76 | 19.3 | 31 | 32 | 37 | | |
| Ckg | 7.0 | - | - | | 6.10 | | | | | | 35 | 33 | 22 | | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 99 | 98 | 88 | 65 | 27 | 35 | 38 | 33 | 14 | 19 | 14 | 117.5 | CL | CL | A6 (9) |
| Ave. of 2 profiles | | | | | 35 | 33 | 32 | 33 | 14 | 19 | | | CL | CL | A6 (9) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 3W<br>I | | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderately rapid (.5-15 cm/hr) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (k = .25) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | Moderate (K = .29) | Slope range | o - 5% |
| Flooding hazard | High (frequent) | Slope stability | NA |
| Frost heave potential | High | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Wetness, texture (CL) |
| Source of sand | Very poor | Unified soil group, CL texture |
| Source of gravel | Very poor | Unified soil group, CL texture |
| Source of roadfill | Poor | Shrink-swell, frost action, wetness |
| Road location | Severe | Shrink-swell, frost action, wetness |
| Permanent buildings | Severe | Wetness, flooding hazard |
| Shallow excavations | Severe | Wetness, seasonably high water table |
| Septic tank absorption fields | Very severe | Wetness, flooding hazard |
| Sanitary landfills | Very severe | Flooding hazard, wetness |
| Reservoir areas | Severe | High water table, flooding hazard |
| Camp areas | Very severe | Flooding hazard, wetness |
| Picnic areas | Severe | Flooding hazard, wetness |
| Paths and trails | Severe | Flooding hazard, wetness |

## Appendix A. (continued)

**Soil Series:** Leighton Centre **Series Symbol:** LTC **Sampled Soil Unit:** LTC 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 5644 hectares, 2.37% of total area
**Classification:** Dark Gray Luvisol (CSSC 78) Typic Cryoboralf (soil taxonomy)
**Landforms:** Morainal veneer over ridged bedrock
**Drainage:** Well drained, rapid downslope surface runoff
**Parent Material:** Fine loamy till
**Comments:** Cut exposes Orthic Gray Luvisol, Dark Gray Luvisol and Cumulic Black Chernozemic profiles all in close proximity

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 23 / ¼ SEC — 21 / TWP — 3 / R — W5 / M **Sampled by:** RM & DL **Sample date:** Sept. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| LH | +7.5<br>0 | 10YR 2/1m | leaf litter | | | clear smooth | 0 |
| Ahe | 8 | 10YR 2/1m<br>10YR 3/2d | loam | moderate, fine granular | very friable, moist | clear smooth | 1% |
| Ae | 28 | 10YR 5/3d | loam | weak, coarse, platy | friable, moist, slightly hard, dry | clear smooth | 5% |
| AB | 38 | 10YR 4/3m | silty clay loam | moderate, fine-medium subangular blocky | hard (dry) firm (moist) | gradual smooth | 5% |
| Bt | 85 | 10YR 3/3m | silty clay loam | moderate, medium subangular blocky | hard (dry) firm (moist) | abrupt wavy | 5% |
| Ck | | | | massive | | | 10-15% |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | 5.8 | 1.55 | 26.40 | 17 | | 0.05 | 1.89 | 54.79 | 4.95 | 75.0 | - | - | - | | |
| Ahe | 5.5 | 0.46 | 5.69 | 12 | | 0.06 | 1.36 | 26.21 | 3.95 | 38.0 | 17 | 52 | 31 | | |
| Ae | 6.3 | 0.09 | 0.97 | 11 | | 0.03 | 0.73 | 12.44 | 2.20 | 17.5 | 15 | 57 | 28 | | |
| AB | 5.7 | 0.08 | 1.00 | 13 | | 0.07 | 0.75 | 15.28 | 3.02 | 20.7 | 15 | 49 | 36 | | |
| Bt | 5.7 | 0.06 | 0.65 | 11 | | 0.06 | 0.54 | 20.78 | 4.82 | 26.6 | 15 | 44 | 41 | | |
| Ck | 7.4 | | | | 5.3 | | | | | | 26 | 46 | 28 | | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 91 | 89 | 79 | 53 | 22 | 41 | 37 | 33 | 20 | 13 | 20 | 102.5 | CL | CL | A6 (5) |
| Ave. of 7 profiles | | | | | 20 | 52 | 28 | 34 | 21 | 13 | | | SiL | CL | A6(5) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 4D | 4D | 4D | 5TD | 6TD |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate (1.5 - 5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Low (K = .17) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .46) | Slope range | 2 - 100% |
| Flooding hazard | Low | Slope stability | |
| Frost heave potential | Moderate-high | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Ahe horizon, thickness of Ah |
| Source of sand | Very poor | Unified soil group (CL), soil texture |
| Source of gravel | Very poor | Unified soil group (CL) |
| Source of roadfill | Fair-poor | Shrink-swell, frost action |
| Road location | Moderate-severe | Shrink-swell, frost action |
| Permanent buildings | Moderate | Slope |
| Shallow excavations | Slight-moderate | Slope, depth to bedrock |
| Septic tank absorption fields | Moderate | Permeability, slope |
| Sanitary landfills | Moderate | Texture (SiCL), slope, permeability, depth to bedrock |
| Reservoir areas | Severe | Slope |
| Camp areas | Moderate-severe | Slope |
| Picnic areas | Moderate-severe | Slope |
| Paths and trails | Moderate | Slope |

## Appendix A. (continued)

**Soil Series:** Lloyd Lake **Series Symbol:** LLK **Sampled Soil Unit:** LLK 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 12 837 hectares, 5.40% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Level to undulating glaciolacustrine
**Drainage:** Well drained, dendritic surface drainage pattern
**Parent Material:** Fine silty to fine clayey glaciolacustrine
**Comments:** Sample taken at soil climate monitoring site.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 3 (¼ SEC) 25 (TWP) 3 (R) W5 (M) **Sampled by:** RM **Sample date:** June 1979

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ap | 30 | 10YR 2/1m | loam | strong, fine-medium granular | friable (moist) | clear wavy | 0 |
| Bm | 69 | 10YR 3/2 - 3/3m | clay loam | weak medium prismatic | friable (moist) | abrupt smooth | 0 |
| Cca | 107 | 2.5Y 5/2m 10YR 7/1d | silty clay loam | amorphous | firm (moist) | diffuse smooth | 0 |
| Ck | - | 2.5Y 5/2m | clay | amorphous | firm (moist) | | 0 |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | $\%CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | 7.2 | .51 | 6.48 | 13 | | .14 | 1.13 | 36.6 | 6.15 | 72.4 | 2 | 50 | 48 | SiC | |
| Bm | 6.7 | .17 | 1.90 | 11 | | .06 | .70 | 16.47 | 8.56 | 38.6 | 2 | 53 | 45 | SiC | |
| Cca | 7.3 | - | - | - | 25.19 | - | - | - | - | - | 0 | 60 | 40 | SiC-SiCL | |
| Ck | 7.8 | - | - | - | 15.37 | - | - | - | - | - | - | - | - | - | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 100 | 100 | 96 | 3 | 56 | 41 | 45 | 21 | 24 | 22 | 100.0 | SiC | CL | A)7)6 (15) |
| Ave. of 17 profiles | | | | | 10 | 58 | 32 | 36 | 22 | 14 | | | SiCL | CL | A6 (10) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 2C | 2C | 3T | 4T | 5T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | 2176 | 1998 | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate low (.5 - 1.5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Low (K = .10) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .37) | Slope range | 2 - 30% |
| Flooding hazard | Low | Slope stability | Susceptible to gully erosion |
| Frost heave potential | Moderate-high | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Good-fair | Thickness of Ah, silty clay loam texture |
| Source of sand | Very poor | Unified soil group (CL), silty clay loam texture |
| Source of gravel | Very poor | Unified soil group (CL), silty clay loam texture |
| Source of roadfill | Poor-fair | Shrink-swell, frost action |
| Road location | Moderate | Shrink-swell, frost action |
| Permanent buildings | Moderate | Shrink-swell, frost action |
| Shallow excavations | Slight-moderate | No significant limitations |
| Septic tank absorption fields | Moderate-severe | Slow permeability |
| Sanitary landfills | Slight-moderate | Silty clay loam texture |
| Reservoir areas | Slight-moderate | No significant limitations |
| Camp areas | Moderate | Texture (SiCL), slow permeability |
| Picnic areas | Slight | Texture (SiCL), slow permeability |
| Paths and trails | Moderate | Texture (SiCL) |

# Appendix A. (continued)

**Soil Series:** Lloyd Lake (Taxadjunct) **Series Symbol:** no series symbol **Sampled Soil Unit:** LLK 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 12 837 hectares, 5.40% of total area
**Classification:** Calcareous Black (CSSC 78)Haplic Udic Calciboroll (soil taxonomy)
**Landforms:** Undulating glaciolacustrine
**Drainage:** Well drained, dendritic surface drainage features
**Parent Material:** Fine silty to fine clayey glaciolacustrine
**Comments:** Soil is very similar to Lloyd Lake except for presence of carbonate in the upper horizons.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 32 (¼ SEC) 21 (TWP) 1 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahk1 | 15 | 10YR 2/1d | loam | moderate-strong, medium-coarse granular | slightly hard (dry) very friable (moist) | clear smooth | tr. |
| Ahk2 | 30 | 10YR 2/1d 10YR 3/1m | loam | moderate-strong, medium-coarse prismatic | slightly hard (dry) very friable (moist) | gradual smooth | 0 |
| Bmk | 36 | 10YR 4/2d 10YR 3/2m | silt loam | moderate, medium-coarse prismatic | slightly hard (dry) very friable (moist) | clear wavy | 0 |
| Cca | 50 | 10YR 7/2d 10YR 4/2m | silt loam | amorphous to coarse prismatic | slightly hard (dry) very friable (moist) | gradual smooth | 0 |
| Ck | | 10YR 6/2d 10YR 6/3m | silt loam | amorphous and pseudo-platy | very friable (moist) loose (dry) | | 0 |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahk1 | 7.4 | 0.44 | 6.63 | 15 | 3.0 | - | - | - | - | - | 20 | 49 | 31 | SiC-CL | |
| Ahk2 | 7.4 | 0.33 | 5.04 | 15 | 6.8 | - | - | - | - | - | 26 | 46 | 28 | CL-L | |
| Bmk | 7.6 | 0.21 | 5.19 | - | 23.1 | - | - | - | - | - | 34 | 41 | 25 | L | |
| Cca | 7.8 | - | - | - | 38.0 | - | - | - | - | - | 16 | 57 | 27 | SiL | |
| Ck | 8.1 | - | - | - | 35.9 | - | - | - | - | - | 11 | 71 | 18 | SiL | |
| PM | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 99 | 98 | 97 | 91 | 13 | 54 | 33 | 32 | 22 | 10 | 22 | 97.5 | SiCL | CL | A4 (8) |
| Ave. of 2 profiles | | | | | 7 | 54 | 39 | 38 | 23 | 15 | | | SiCL | CL | A6 (10) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 2C | 2C | 3T | 4T | 5T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate slow (.5 - 1.5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Severe (K = .52) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | Moderate (K = .25) | Slope range | 2 - 30% |
| Flooding hazard | Low | Slope stability | Susceptible to gully erosion |
| Frost heave potential | Moderate-high (F4) | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair | Silty clay to clay loam texture |
| Source of sand | Very poor | Unified soil group (CL), silt loam texture |
| Source of gravel | Very poor | Unified soil group (CL), silt loam texture |
| Source of roadfill | Poor-fair | Shrink-swell, frost action |
| Road location | Moderate | Shrink-swell, frost action |
| Permanent buildings | Moderate | Shrink-swell, frost action |
| Shallow excavations | Slight-moderate | No significant limitations |
| Septic tank absorption fields | Moderate-severe | Slow permeability |
| Sanitary landfills | Slight-moderate | Silty clay loam texture |
| Reservoir areas | Slight-moderate | No significant limitations |
| Camp areas | Moderate | Clay loam surface texture |
| Picnic areas | Slight-moderate | Clay loam surface texture |
| Paths and trails | Slight-moderate | Clay loam surface texture |

## Appendix A. (continued)

**Soil Series:** Midnapore **Series Symbol:** MDP **Sampled Soil Unit:** MDP 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 4415 hectares, 1.84% of total area
**Classification:** Orthic Black (CSSC 78) hectares, 1.84% of total area
**Landforms:** Glaciofluvial level to undulating
**Drainage:** Well to rapidly drained, dendritic surface drainage pattern
**Parent Material:** Sandy to coarse loamy glaciofluvial
**Comments:** Isolated patch of glaciofluvial sediment in meltwater channel.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 24 (¼ SEC) 21 (TWP) 1 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 26 | 10YR 2/1 | loam-sandy loam | weak fine granular | very friable (moist) | clear smooth | 0 |
| Bm | 45 | 10YR 3/3 | sandy loam | amorphous | loose (dry) | loose (dry) | 0 |
| Cca | - | 10YR 5/4 | sandy loam | amorphous | loose (dry) | loose (dry) | 0 |

### CHEMICAL ANALYSIS OF REPHESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.7 | .31 | 5.60 | 18 | - | .03 | .38 | 30.31 | 4.10 | 33.4 | 39 | 41 | 20 | CL | |
| Bm | 7.1 | .11 | 1.44 | 13 | - | .08 | .43 | 22.91 | 4.30 | 24.8 | 29 | 51 | 20 | L | |
| Ck | 7.7 | - | - | - | 23.1 | - | - | - | - | - | 64 | 39 | 5 | SL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 100 | 95 | 33 | 65 | 15 | 20 | 21 | 19 | 2 | 17 | 107.5 | SL-SCL | SM | A-2-4 (0) |
| Ave. of 3 profiles | | | | | 55 | 37 | 11 | 22 | 18 | 3 | | | SL | SM | A-2-4 (0) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 2M | 2M | 3MT | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Moderate rapid (5 - 15) |
| Compressibility | Low-moderate | Permeability-compacted | Moderate |
| Corrosion potential | Low | Shear strength | Moderate |
| Erodibility-topsoil | Moderate (K = .23) | Shrink-swell potential | Low |
| Erodibility-subsoil | High (K = .61) | Slope range | .5 - 15 |
| Flooding hazard | Low | Slope stability | |
| Frost heave potential | Low | Workability of material | Fair-good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Good | No significant limitations |
| Source of sand | Poor-fair | Unified soil group (SM), soil texture (SL) |
| Source of gravel | Very poor | Unified soil group (SM), soil texture (SL) |
| Source of roadfill | Good | No significant limitations |
| Road location | Slight-moderate | Frost hazard, shrink-swell |
| Permanent buildings | Slight-moderate | Frost hazard, shrink-swell |
| Shallow excavations | Slight-moderate | No significant limitations |
| Septic tank absorption fields | Slight-moderate | No significnt limitations |
| Sanitary landfills | Severe | Rapid permeability |
| Reservoir areas | Severe | Rapid permeability |
| Camp areas | Slight | No significant limitations |
| Picnic areas | Slight | No significant limitations |
| Paths and trails | Slight | No significant limitations |

## Appendix A. (continued)

**Soil Series:** Midnapore **Series Symbol:** MDP **Sampled Soil Unit:** MDAD 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 2684 hectares, 1.13% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Glaciofluvial veneer to blanket overlying till; undulating
**Drainage:** Well drained
**Parent Material:** Sandy to coarse loamy glaciofluvial
**Comments:** Sampled in area of variable sand and silty veneer over till.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 15 (¼ SEC) 21 (TWP) 28 (R) W4 (M) **Sampled by:** RM **Sample date:** Nov. 1980

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ap* | 34 | 10YR 2/1m | silt loam | moderate fine granular | very friable, moist | clear smooth | 0 |
| Bm | 62 | 10YR 3/3m | silt loam | weak-moderate, medium, prismatic | friable, moist | abrupt smooth | 0 |
| Cca | 85 | 10YR 5/3m | silt loam | amorphous | friable, moist | gradual smooth | 0 |
| Ck | 110 | 10YR 5/3m | silt loam | amorphous | friable, moist loose, dry | clear smooth | 0 |
| IICk | | 2.5Y 5/2m | sandy clay loam | massive | friable-firm, moist | | 3% |

*Ap is very thick but thins upslope to about 15-20 cm

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | 6.9 | 0.39 | 5.32 | 14 | | 0.02 | 3.26 | 27.38 | 3.74 | 33.4 | 33 | 42 | 25 | L | |
| Bm | 6.9 | 0.13 | 1.30 | 10 | | 0.14 | 1.05 | 13.84 | 2.97 | 17.5 | 28 | 49 | 24 | L | |
| Cca | 7.5 | | | | 38.38 | | | | | | - | - | - | | |
| Ck | 7.5 | | | | 23.77 | | | | | | 42 | 41 | 17 | L | |
| IICk | 7.6 | | | | 11.11 | | | | | | 52 | 31 | 17 | SL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 51 | 47 | 37 | 26 | 36 | 41 | 23 | 24 | 19 | 5 | 18 | 107.5 | L | SW-SM | A-2-4 (0) |
| Ave. of 3 profiles | | | | | 55 | 37 | 11 | 22 | 18 | 3 | | | SL | SW-SM | A-2-4 (0) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 2M | 2M | 3MT | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Moderate rapid (5 - 15) |
| Compressibility | Low-moderate | Permeability-compacted | Moderate |
| Corrosion potential | Low | Shear strength | Moderate |
| Erodibility-topsoil | Moderate (K = .23) | Shrink-swell potential | Low |
| Erodibility-subsoil | High (K = .61) | Slope range | .5 - 15 |
| Flooding hazard | Low | Slope stability | |
| Frost heave potential | Low | Workability of material | Fair-good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Good | No significant limitations |
| Source of sand | Poor-fair | Unified soil group (SW-SC), soil texture (SL) |
| Source of gravel | Very poor | Unified soil group (SW-SC), soil texture (SL) |
| Source of roadfill | Good | No significant limitations |
| Road location | Slight-moderate | Frost hazard, shrink-swell |
| Permanent buildings | Slight-moderate | Frost hazard, shrink-swell |
| Shallow excavations | Slight-moderate | No significnt limitations |
| Septic tank absorption fields | Slight-moderate | No significant limitations |
| Sanitary landfills | Severe | Rapid permeability |
| Reservoir areas | Severe | Rapid permeability |
| Camp areas | Slight | No significant limitations |
| Picnic areas | Slight | No significant limitations |
| Paths and trails | Slight | |

## Appendix A. (continued)

**Soil Series:** Mesa Butte **Series Symbol:** MSB **Sampled Soil Unit:** MSB 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1338 hectares, 0.56% of total area
**Classification:** Orthic Black - lithic phase (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Colluvial veneer over steep rock
**Drainage:** Well to rapidly drained
**Parent Material:** Fine silty to loamy skeletal colluvium over rock
**Comments:** Composed largely of small shale fragments. Fragments were crushed for analysis giving misleading idea of material texture.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 12 / ¼ SEC; 21 / TWP; 3 / R; W5 / M **Sampled by:** RM & DL **Sample date:** Sept. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 15 (10-17) | 10YR 3/2m | loam | weak fine granular | very friable - friable (moist) | clear wavy | 10-15% (1-3 cm dia) |
| Bm | 45 | 10YR 3/4m | silty clay loam | amorphous | friable (moist) | gradual wavy | 5-10% small ss |
| BC | 55 | 10YR 3/3 | silt loam | amorphous | friable (moist) | gradual wavy | fragments |
| R | - | 2.5Y 4/4 | weathered sandstone | - | - | | |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 5.6 | .27 | 2.57 | 10 | - | .03 | .87 | 16.72 | 3.38 | 25.4 | 40 | 29 | 31 | | |
| Bm | 6.2 | .15 | 1.31 | 9 | - | .42 | .49 | 25.88 | 7.33 | 35.4 | 4 | 56 | 40 | | |
| BC | 6.5 | .09 | .90 | 10 | .1 | .10 | .40 | 23.53 | 6.30 | 31.3 | 6 | 67 | 27 | | |
| PM | - | - | - | - | - | - | - | - | - | - | 16 | 60 | 24 | | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | 91 | 16 | 60 | 24 | 32 | 22 | 10 | 22 | 97:5 | SiL | CL | A4 (8) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | | | 5C | 6T | 6T 5(RT)5 |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Rapid (15 - 50) |
| Compressibility | Moderate-low | Permeability-compacted | Moderate |
| Corrosion potential | Low | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .21) | Shrink-swell potential | Moderate-low |
| Erodibility-subsoil | High (K = .52) | Slope range | 10 - 100% |
| Flooding hazard | Low | Slope stability | Susceptible to soil creep |
| Frost heave potential | Moderate | Workability of material | Fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor-very poor | Thickness of Ah, steep slopes |
| Source of sand | Very poor | Unified soil group (CL), soil texture |
| Source of gravel | Very poor | Unified soil group (CL), soil texture |
| Source of roadfill | Poor | Shrink-swell, frost action, slope, depth to bedrock |
| Road location | Severe | Slope, depth to bedrock, frost heave |
| Permanent buildings | Severe | Slope, frost heave, depth to bedrock |
| Shallow excavations | Severe | Depth to bedrock, slope |
| Septic tank absorption fields | Severe | Depth to bedrock, slope |
| Sanitary landfills | Very severe | Depth to bedrock, slope |
| Reservoir areas | Severe | Slope, depth to bedrock |
| Camp areas | Moderate-severe | Slope |
| Picnic areas | Moderate-severe | Slope |
| Paths and trails | Moderate | Slope |

## Appendix A. (continued)

**Soil Series:** Nose Creek **Series Symbol:** NSK **Sampled Soil Unit:** NSK 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1800 hectares, 0.74% of total area
**Classification:** Rego Black (CSSC 78) Entic Udic Haploboroll (soil taxonomy)
**Landforms:** Undulating to level (bevelled) morainal in scoured meltwater channel
**Drainage:** Well drained, central drainage channel
**Parent Material:** Fine silty to fine loamy till
**Comments:** Sampled in ditch cut in bevelled terrace of old meltwater channel.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 25 (¼ SEC) 26 (TWP) 1 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1978

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 10 | 10YR 2/1 | loam | moderate fine granular | friable (moist) | clear smooth | 0 |
| Ck | - | 2.5Y 5/4m 2.5Y 6/4d | silty clay loam-clay loam | amorphous | firm (moist) | - | 10% |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.4 | 0.82 | 8.22 | 10 | - | - | - | - | - | - | 24 | 48 | 28 | CL (SiCL-L) | |
| Ck | 8.0 | - | - | - | 42.9 | - | - | - | - | - | 18 | 58 | 24 | SiL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 91 | 88 | 83 | 73 | 20 | 46 | 34 | 32 | 18 | 14 | 17 | 107.5 | CL-SiCL | CL | A6 (9) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 3(SP) | 3(SP) | 4(ST) | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate (1.5 - 5.0) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate |
| Erodibility-topsoil | Moderate (K = .21) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .57) | Slope range | 2 - 9 |
| Flooding hazard | Moderate-high | Slope stability | NA |
| Frost heave potential | Moderate | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thin Ah horizon |
| Source of sand | Very poor | Unified soil group (CL), soil texture |
| Source of gravel | Very poor | Unified soil group (CL), soil texture |
| Source of roadfill | Fair-good | Moderate to high frost heave; AASHO |
| Road location | Moderate | Frost heave, shrink-swell, flooding |
| Permanent buildings | Moderate | Shrink-swell, seasonal water table, depth to bedrock |
| Shallow excavations | Moderate | Drainage class, seasonal water table, depth to bedrock |
| Septic tank absorption fields | Moderate | Moderate permeability |
| Sanitary landfills | Moderate | Silty clay loam texture, depth to bedrock |
| Reservoir areas | Moderate | Moderate permeability, depth to bedrock |
| Camp areas | Moderate | Flooding, silty clay loam texture |
| Picnic areas | Moderate | Flooding, silty clay loam texture |
| Paths and trails | Moderate | Flooding, silty clay loam texture |

## Appendix A. (continued)

**Soil Series:** Porcupine **Series Symbol:** PUP **Sampled Soil Unit:** LTC 1

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:**
**Classification:** Orthic Black, cumulic phase (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Colluvial or fluvial veneer overlying inclined to steep morainal
**Drainage:** Well to moderately well drained, often located in moist drews and gullies
**Parent Material:** Fine loamy fluvial or colluvial overlying till (or sometimes glaciolacustrine)
**Comments:** This profile is typical of the "slope wash" soils recognized in many soil units located on hillslopes.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 23 (¼ SEC) 21 (TWP) 3 (R) W5 (M) **Sampled by:** RM & DL **Sample date:** Sept. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah1 | 15 | 10YR 2/1 | loam | fine granular | soft (dry) very friable (moist) | gradual smooth | 1-2% |
| Ah2 | 60 | 10YR 3/1d 10YR 5/3d | loam | moderate, fine-medium granular | friable (moist) | gradual smooth | 1-2% |
| Ah3 | 80 | 7.5YR 3/2 | loam | moderate, fine-medium subangular blocky | friable (moist) | clear smooth | 1-2% |
| IIBm | 105 | 10YR 5/3 to 5/4d | silty clay loam | moderate, fine-medium subangular blocky | firm (moist) hard (dry) | gradual smooth | 10% |
| IIBC | - | 2.5Y 4/2m | loam to silty clay loam | amorphous | friable-firm (moist) slightly hard (dry) | - | 10% |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah1 | 5.5 | .46 | 5.69 | 12 | - | .06 | 1.36 | 26.21 | 3.95 | 38.0 | 17 | 52 | 31 | SiCL | |
| Ah2 | 5.7 | .23 | 2.57 | 11 | - | .05 | .94 | 20.98 | 3.97 | 29.6 | 16 | 50 | 34 | SoC: | |
| Ah3 | 6.1 | .19 | 2.07 | 11 | - | .11 | .63 | 20.50 | 4.97 | 29.0 | 10 | 56 | 34 | SiCL | |
| IIBM | 6.3 | .06 | 0.57 | 10 | - | .07 | .52 | 17.31 | 6.81 | 23.7 | 25 | 42 | 33 | CL | |
| IIBC | 6.6 | - | - | - | 0.1 | .06 | .50 | 19.53 | 8.35 | 27.5 | 16 | 49 | 35 | SiCL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

**CLI Capability for Agriculture**

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | | 3C | 4T | 5T | 6T |

**Estimated Yields of Common Crops**

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

**Estimated Engineering Behavior (Design Considerations)**

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | | Permeability-unaltered | |
| Compressibility | | Permeability-compacted | |
| Corrosion potential | | Shear strength | |
| Erodibility-topsoil | | Shrink-swell potential | |
| Erodibility-subsoil | | Slope range | |
| Flooding hazard | | Slope stability | |
| Frost heave potential | | Workability of material | |

**Suitabilities and Limitations for Selected Uses**

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair | Silty clay loam surface texture |
| Source of sand | Very poor | Unified soil group, soil texture (SiCL) |
| Source of gravel | Very poor | Unified soil group, soil texture (SiCL) |
| Source of roadfill | Fair-poor | Frost heave, slope, depth to bedrock |
| Road location | Moderate-severe | Frost heave, slope, depth to bedrock |
| Permanent buildings | Severe | Slope, frost heave, depth to bedrock |
| Shallow excavations | Moderate | Slope, depth to bedrock |
| Septic tank absorption fields | Moderate-severe | Slope, depth to bedrock |
| Sanitary landfills | Moderate-severe | Slope, depth to bedrock |
| Reservoir areas | Severe | Slope |
| Camp areas | Moderate-severe | Slope |
| Picnic areas | Moderate-severe | Slope |
| Paths and trails | Moderate-severe | slope |

# Appendix A. (continued)

**Soil Series:** Pothole Creek **Series Symbol:** POT **Sampled Soil Unit:** POT 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 2813 hectares, 1.16% of total area
**Classification:** Orthic Humic Gleysol (CSSC 78) Haplaquoll (soil taxonomy)
**Landforms:** Level to depressional lacustrine veneer over glaciolacustrine
**Drainage:** Poorly drained, local undrained depressions
**Parent Material:** Fine to very firm clayey recent lacustrine or glaciolacustrine
**Comments:** Sampled in wet depressions.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 33 / ¼ SEC — 21 / TWP — 4 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 10 | 10YR 2/1 | loam | coarse-fine granular | very friable (moist) | clear smooth | 0% |
| Ahg | 30 | 2.5Y 2/1 | clay-clay loam | medium granular | very firm (moist) | abrupt smooth | 0% |
| Bg | 80 | 5Y 3/2 | clay | moderate medium granular fine sub-angular blocky | very firm | abrupt smooth | 0% |
| Ckg | - | 2.5Y 4/2 | clay | amorphous | very firm | - | 0% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.2 | - | 7.26 | - | - | - | - | - | - | - | - | - | - | | |
| Ahg | 6.1 | .39 | 5.58 | - | - | .09 | .72 | 39.09 | 11.58 | 43.9 | 4 | 48 | 48 | SiC | |
| Bg | 6.4 | .07 | 1.22 | - | - | .12 | .76 | 34.56 | 13.88 | 38.6 | - | 34 | 66 | HC | |
| Ckg | 7.5 | - | - | - | 1.42 | - | - | - | - | - | 1 | 23 | 76 | HC | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 95 | 94 | 93 | 92 | 2 | 24 | 74 | 64 | 26 | 38 | 27 | 92.5 | HC | MH | A-7-6 (20) |
| Ave. of profiles | | | | | 9 | 42 | 49 | 46 | 23 | 23 | | | SiC | CL | A-7-6 (14) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | 6W | 6W | | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Poor | Permeability-unaltered | Slow (.15 - .5) |
| Compressibility | High | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Low |
| Erodibility-topsoil | Low (K = .19) | Shrink-swell potential | High |
| Erodibility-subsoil | Low (K = .19) | Slope range | 0 - 5 |
| Flooding hazard | High, frequent flooding | Slope stability | NA |
| Frost heave potential | High | Workability of material | Poor |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Wetness, thickness of Ah |
| Source of sand | Very poor | Wetness, unified soil group, soil texture |
| Source of gravel | Very poor | Wetness, unified soil group, soil texture |
| Source of roadfill | Very poor | Frost action, wetness, AASHO |
| Road location | Very poor | Wetness, shrink-swell, AASHO |
| Permanent buildings | Severe | Wetness, shrink-swell, frost action |
| Shallow excavations | Severe | Wetness, seasonal water table |
| Septic tank absorption fields | Very severe | Wetness |
| Sanitary landfills | Very severe | Wetness |
| Reservoir areas | Severe | Depth to water table, flooding hazard |
| Camp areas | Severe | Wetness |
| Picnic areas | Severe | Wetness |
| Paths and trails | Severe | Wetness |

## Appendix A. (continued)

**Soil Series:** Rockyview **Series Symbol:** RKV **Sampled Soil Unit:** RKAD 5

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 14 475 hectares, 6.08% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Thin discontinuous aeolian veneer over level to undulating morainal
**Drainage:** Well drained, few major surface drainage features
**Parent Material:** Fine silty to fine loamy aeolian overlying till
**Comments:**

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 12 / ¼ SEC — 26 / TWP — 1 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1978

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 15 | 10YR 2/1d | loam | moderate fine granular weak medium prismatic | very friable (moist) slightly hard-soft (dry) | clear smooth | 0 |
| Bm | 40 | 10YR 5/4d 10YR 4/4m | loam | strong medium prismatic | slightly hard-hard (dry) friable (moist) | abrupt smooth | 0 |
| Ck | 60 | 2.5Y 5/4m | silty clay loam | amorphous | firm (moist) slightly hard (dry) | diffuse smooth | 1-2% |
| Cca | - | 2.5Y 5/4m | silty clay loam | amorphous | firm (moist) slightly hard (dry) | - | |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.4 | 0.58 | 6.61 | 11 | - | - | - | - | - | - | 16 | 65 | 19 | SiL | |
| Bm | 7.4 | 0.16 | 1.53 | 10 | - | - | - | - | - | - | 21 | 54 | 25 | SiL | |
| Cca | 7.9 | - | - | - | 27.6 | - | - | - | - | - | - | - | - | - | |
| Ck | 7.8 | - | - | - | 25.5 | - | - | - | - | - | 15 | 66 | 19 | SiL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 100 | 98 | 81 | 20 | 57 | 23 | 25 | 16 | 9 | 14 | 115.0 | SiL | CL | A4 (8) |
| Ave. of profiles | | | | | 20 | 53 | 27 | 34 | 21 | 13 | | | SiL | CL | A4 (9) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 1 | 2T | 3T | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | 3002 | |
| Stubble | | | 2155 | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate (1.5-5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate |
| Erodibility-topsoil | Moderate (K = .30) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .58) | Slope range | 2 - 15 |
| Flooding hazard | Low | Slope stability | |
| Frost heave potential | Moderate-high | Workability of material | Fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair-good | Thickness of Ah |
| Source of sand | Very poor | Unified soil group, soil texture |
| Source of gravel | Very poor | Unified soil group, soil texture |
| Source of roadfill | Fair | Shrink-swell, AASHO, frost heave |
| Road location | Moderate | Frost heave, shrink-swell, AASHO |
| Permanent buildings | Moderate | Frost heave, shrink-swell, AASHO |
| Shallow excavations | Slight | No significant limitations |
| Septic tank absorption fields | Moderate | Moderate permeability |
| Sanitary landfills | Slight | No significant limitations |
| Reservoir areas | Slight-moderate | Moderate permeability |
| Camp areas | Slight-moderate | Silt loam surface texture |
| Picnic areas | Slight-moderate | Silt loam surface texture |
| Paths and trails | Slight-moderate | Silt loam surface texture |

# Appendix A. (continued)

**Soil Series:** Red Deer Lake **Series Symbol:** RDL **Sampled Soil Unit:** LLK 2

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:**
**Classification:** Gleyed Black Solodized Solonetz (CSSC 78) Udic Natriboroll (soil taxonomy)
**Landforms:** Level to depressional glaciolacustrine
**Drainage:** Moderately well to imperfectly drained, dendritic pattern
**Parent Material:** Fine silty to fine clayey glaciolacustrine
**Comments:** Found in only 1 area in association with Lloyd Lake soils.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 28 (¼ SEC) 22 (TWP) 2 (R) W5 (M) **Sampled by:** RM **Sample date:** June 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 10 | 10YR 2/1 | loam | fine granular | soft-slightly hard (dry) | clear wavy | 1% |
| Ahek | 16 | 10YR 3/2 | loam-very fine sandy loam | fine-medium sub-angular blocky | hard (dry) friable (moist) | clear wavy | $% |
| ABkg | 28 | 10YR 8/1d | silty clay loam to silt loam | strong-medium subangular blocky | hard (dry) | abrupt wavy | 1% |
| Bntkg | 43 | 10YR 8/1d 2.5Y 4/4m | silt loam | strong coarse columnar | very hard (dry) | clear smooth | 0 |
| Bntjkg | 55 | 2.5Y 4/4m | silt loam | weak medium blocky | friable-firm (moist) | gradual smooth | 0 |
| Cskg | - | 2.5Y 4/4m | silt loam - fine sandy loam (SCL) | - | friable (moist) | | |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.8 | 1.17 | 10.72 | - | - | - | - | - | - | - | 9 | 63 | 28 | SiL-SiCL | |
| Ahek | 8.1 | .30 | 3.50 | - | - | - | - | - | - | - | 11 | 65 | 24 | SiCL-SiC | |
| ABkg | 8.4 | .08 | 5.45 | - | - | - | - | - | - | - | 8 | 52 | 40 | SiCL | |
| Bntkg | 8.9 | .07 | 3.71 | - | - | 22.06 | 0.43 | 38.75 | 9.76 | 10.8 | 2 | 64 | 34 | SiCL | |
| Bntjkg | 9.6 | .04 | 0.79 | - | - | 24.77 | 0.46 | 33.52 | 5.92 | 9.9 | 1 | 70 | 29 | SiCL | |
| Cskg | 9.6 | - | - | - | 20.3 | - | - | - | - | - | 1 | 70 | 29 | SiCL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 4D<br>W | | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-poor | Permeability-unaltered | Moderate slow (.5 - 1.5) |
| Compressibility | Moderate-high | Permeability-compacted | Low |
| Corrosion potential | High | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .30) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .54) | Slope range | .5 - 9% |
| Flooding hazard | Moderate (occasional) | Slope stability | |
| Frost heave potential | Moderate (F3) | Workability of material | Fair-poor |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thin Ah, E.C. |
| Source of sand | Very poor | Fine clayey texture |
| Source of gravel | Very poor | Fine clayey texture |
| Source of roadfill | Poor | Shrink-swell, soluble salts |
| Road location | Severe | Frost action, seasonal water table |
| Permanent buildings | Severe | Frost action, concrete corrosion |
| Shallow excavations | Moderate-severe | Seasonal water table, imperfect drainage |
| Septic tank absorption fields | Severe | Wetness, permeability, flooding hazard |
| Sanitary landfills | Severe | Wetness, seasonally high water table |
| Reservoir areas | Severe | Permeability slope, flooding hazard, seasonally high water table |
| Camp areas | Severe | Texture (SiL), wetness, seasonally high water table |
| Picnic areas | Severe | Texture (SiL), wetness |
| Paths and trails | Severe | Texture (SiL), wetness |

## Appendix A. (continued)

**Soil Series:** Unnamed Rough Broken **Series Symbol:** RB **Sampled Soil Unit:** RB 2

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1413 hectares, 0.59% of total area
**Classification:** Cumulic Humic Regosol (CSSC 78) Mollic Udifluvent (soil taxonomy)
**Landforms:** Colluvial veneer over inclined to steep rock
**Drainage:** Well drained, rapid downslope surface drainage
**Parent Material:** Fine loamy colluvial veneer over rock
**Comments:** Multiple Ah horizons are evidence of slope instability and soil creep.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 29 / ¼ SEC — 26 / TWP — 3 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1978

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahj | 20 | 10YR 3/2d<br>10YR 3/1m | loam | stony medium gradual<br>stony medium prismatic | slightly hard (dry)<br>friable (moist) | gradual wavy | 5-10% |
| Ck1 | 30 | 10YR 5/2d | loam | stony medium prismatic | slightly hard (dry)<br>friable (moist) | clear smooth | 5-10% |
| Ahbk1 | 35 | 10YR 4/1d | loam | stony medium prismatic and moderate fine granular | slightly hard (dry)<br>friable (moist) | clear smooth | 5-10% |
| Ck2 | 40 | 10YR 5/2d | clay loam | stony medium prismatic | slightly hard (dry)<br>firm (moist) | clear smooth | 5-10% |
| Ahbk2 | 45 | 10YR 4/1d | loam | stony medium prismatic, moderate fine granular | slightly hard (dry)<br>friable (moist) | clear smooth | 5-10% |
| Ck3 | 48 | | | | | | |
| Ahbk3 | 51 | | | | | | |
| Ck4 | 58 | | | | | | |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.3 | 0.57 | 5.25 | 9 | 1.5 | - | - | - | - | - | 26 | 44 | 30 | CL | |
| Ck1 | 7.5 | 0.32 | 4.10 | 10 | 6.5 | - | - | - | - | - | 29 | 45 | 26 | L | |
| Ahbk1 | 7.5 | 0.44 | 4.40 | 9 | 4.7 | - | - | - | - | - | 22 | 47 | 31 | CL | |
| Ck2 | 7.6 | 0.22 | 3.75 | 9 | 14.0 | - | - | - | - | - | 25 | 46 | 29 | CL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 99 | 96 | 72 | 33 | 41 | 26 | 38 | 24 | 14 | 24 | 95.0 | L | CL | A6 (9) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | | 4T | 5T | 6T | 6T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair | Permeability-unaltered | Moderate (1.5 - 5) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Low |
| Erodibility-topsoil | Moderate (K = .24) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .45) | Slope range | 15 - 100 |
| Flooding hazard | None | Slope stability | Potentially unstable |
| Frost heave potential | Moderate (F3) | Workability of material | Good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor-very poor | Slope |
| Source of sand | Very poor | Unified soil group (CL), soil texture |
| Source of gravel | Very poor | Unified soil group (CL), soil texture |
| Source of roadfill | Fair-poor | Slope, AASHO, shrink-swell |
| Road location | Severe-very severe | Slope, shrink-swell, AASHO |
| Permanent buildings | Very severe | Slope, depth to bedrock |
| Shallow excavations | Severe | Slope, depth to bedrock |
| Septic tank absorption fields | Severe | Slope |
| Sanitary landfills | Moderate-severe | Slope, depth to bedrock |
| Reservoir areas | Severe | Slope |
| Camp areas | Severe-very severe | Slope |
| Picnic areas | Severe-very severe | Slope |
| Paths and trails | Moderate-severe | Slope |

# Appendix A. (continued)

**Soil Series:** Robinson **Series Symbol:** RSN **Sampled Soil Unit:** ELRS 2

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 4580 hectares, 1.91% of total area
**Classification:** Dark Gray Luvisol (CSSC 78) Typic Cryoboralf (soil taxonomy)
**Landforms:** Undulating to gently rolling morainal
**Drainage:** Moderately well drained, dendritic surface drainage patterns
**Parent Material:** Fine clayey till
**Comments:** Till has higher than normal clay content.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 29 / ¼ SEC — 22 / TWP — 3 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahe | 6 | 10YR 3/1m | loam | weak-fine granular | very friable (moist) | clear smooth | 0 |
| Ae | 15 | 10YR 3/2-3/3m 10YR 6/4d | loam | weak-moderate fine platy | very friable-friable (moist) | abrupt smooth | 0 |
| Bt | 60 | 10YR 3/3m | clay | moderate-strong, fine-medium sub-angular blocky | very firm-firm (moist) | gradual smooth | 5% |
| BC | 80 | 2.5Y 4/4 | silty clay | amorphous | firm (moist) | abrupt smooth | 5% |
| Ck | | 2.5Y 4/4 | silty clay loam | pseudo-platy | friable-firm (moist) | - | 5% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | $\%CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahe | 6.2 | - | 8.97 | - | - | - | - | - | - | - | - | - | - | - | |
| Ae | 5.2 | .12 | 1.46 | - | - | .04 | .47 | 9.47 | 2.26 | 15.1 | 14 | 61 | 25 | SiL | |
| Bt | 5.3 | .07 | .73 | - | - | .06 | .62 | 18.3 | 4.51 | 22.7 | 16 | 43 | 41 | SiC | |
| BC | 5.2 | .05 | 0.64 | - | 0.1 | .11 | .27 | 21.31 | 4.82 | 26.8 | 13 | 47 | 40 | SiC-SiCL | |
| Ck | 7.2 | - | - | - | 14.8 | - | - | - | - | - | 14 | 49 | 37 | SiCL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 99 | 98 | 97 | 86 | 13 | 46 | 41 | 40 | 21 | 19 | 22 | 100.0 | SiC | CL | A6 (12) |
| Ave. of 7 profiles | | | | | 9 | 41 | 50 | 49 | 24 | 25 | | | SiC | CL | A7-6 (12) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 5C | 5C | 6T | 6T | 6T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Slow to very slow (< .5) |
| Compressibility | Moderate-high | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .31) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .45) | Slope range | 5 - 45 |
| Flooding hazard | Low (none-infrequent) | Slope stability | |
| Frost heave potential | Moderate-high | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Very poor | Thickness of Ah, clay surface texture |
| Source of sand | Very poor | Unified soil group (CL), soil texture (C) |
| Source of gravel | Very poor | Unified soil group (CL), soil texture (C) |
| Source of roadfill | Poor | Shrink-swell, frost heave, AASHO |
| Road location | Severe | Shrink-swell, frost heave |
| Permanent buildings | Moderate-severe | Shrink-swell, frost heave |
| Shallow excavations | Moderate-severe | Soil drainage class, silty clay loam to silty clay texture |
| Septic tank absorption fields | Moderate-severe | Permeability, percolation rate |
| Sanitary landfills | Moderate-severe | Soil texture (SiCL), wetness |
| Reservoir areas | Slight | No significant limitations |
| Camp areas | Moderate-severe | Surface soil texture (SiL-SiC), slow permeability |
| Picnic areas | Moderate-severe | Surface soil texture (SiL-SiC) |
| Paths and trails | Moderate-severe | Surface soil texture (SiL-SiC) |

# Appendix A. (continued)

**Soil Series:** Strathcona **Series Symbol:** SCO **Sampled Soil Unit:** SCO 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1839 hectares, 0.77% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploborcll (soil taxonomy)
**Landforms:** Glaciofluvial delta - level to undulating
**Drainage:** Rapidly to very rapidly, no major surface drainage features
**Parent Material:** Loamy skeletal glaciofluvial (gravels)
**Comments:** Sampled in small gravel pit.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SW 14 / ¼ SEC — 21 / TWP — 1 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 15 | 10YR 2/1d<br>10YR 3/1d | loam | weak medium prismatic, fine granular | slightly hard-soft (dry) very friable (moist) | clear wavy | 5% |
| Bm1 | 22 | 7.5YR 4/4 | loam | weak medium prismatic | slightly hard (dry) | gradual wavy | 15% |
| IIBm2 | 40 | 7.5YR 3/2m<br>10YR 5/2d | graven + fine sandy loam | single grain | loose (dry) | clear smooth | 35% |
| IICca | - | 10YR 6/2d | gravel + sand | single grain | loose (dry) | | 70% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 7.1 | .79 | 10.44 | 13 | - | - | - | - | - | - | 21 | 52 | 27 | SiL-L | |
| Bm1 | 6.0 | .21 | 2.16 | 10 | - | .04 | .30 | 17.19 | 3.69 | 20.1 | 32 | 43 | 25 | L | |
| IIBm2 | 7.2 | .23 | 4.34 | 19 | - | - | - | - | - | - | 38 | 46 | 16 | GVL | |
| IICk | 7.5 | - | - | - | 28.1 | - | - | - | - | - | 41 | 42 | 17 | GVL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 5(MP) | 5(MP) | 6(TM) | 6(TM) | 6(TM) |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Rapid (15-50 cm/hr) |
| Compressibility | Low | Permeability-compacted | High |
| Corrosion potential | Low | Shear strength | High |
| Erodibility-topsoil | Moderate K = .24) | Shrink-swell potential | Low |
| Erodibility-subsoil | Moderate (K = .34) | Slope range | .5 - 15% |
| Flooding hazard | Low (none-infrequent) | Slope stability | - |
| Frost heave potential | Low-moderate (F1-2) | Workability of material | Good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thickness of Ah, flooding hazard, stoniness |
| Source of sand | Poor | Unified soil group (GP-GC) |
| Source of gravel | Good-fair | Unified soil group (GP-GC) |
| Source of roadfill | Good | No significant limitations except slope |
| Road location | Slight | No significant limitations except slope |
| Permanent buildings | Slight | No significant limitations except slope |
| Shallow excavations | Severe | Gravelly soil, stoniness, slope |
| Septic tank absorption fields | Slight | No significant limitations except slope |
| Sanitary landfills | Very severe | Rapid permeability |
| Reservoir areas | Severe | Rapid permeability, unified soil group, stoniness |
| Camp areas | Severe | Surface stoniness, slope |
| Picnic areas | Moderate | Surface stoniness, slope |
| Paths and trails | Moderate | Surface stoniness, slope |

# Appendix A. (continued)

**Soil Series:** Sharp Hill **Series Symbol:** SHL **Sampled Soil Unit:** HPAD 2

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:**
**Classification:** Rego Black (CSSC 78) Udic Calciboroll (soil taxonomy)
**Landforms:** Ridged morainal and glaciofluvial (washboard)
**Drainage:** Well to rapidly drained, no large scale surface drainage features
**Parent Material:** Mixed till and sandy glaciofluvial
**Comments:** Bank exposes mixed till and glaciofluvial. Rego and Orthic soils are both present.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 14 (¼ SEC) 21 (TWP) 29 (R) W4 (M) **Sampled by:** RM **Sample date:** Nov. 1980

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ap | 15 | 10YR 3/1m | loam | moderate, fine, granular | friable, moist | clear smooth | 0 |
| Cca | 30 | 10YR 7/2d | sandy clay loam | amorphous to pseudo-platy | hard, dry, friable, moist | gradual smooth | 2% |
| Ck | | 2.5Y 5/2m | sandy loam to sandy clay loam | amorphous | friable to firm, (moist), hard, dry | | 2% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | $\%CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | 7.2 | 0.34 | 4.25 | 13 | | | | | | | 43 | 41 | 16 | L | |
| Cca | 7.6 | | | | 15.19 | | | | | | 36 | 48 | 16 | L | |
| Ck | 8.1 | | | | 11.53 | | | | | | 42 | 40 | 18 | L | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 99 | 98 | 91 | 66 | 33 | 41 | 26 | 22 | 14 | 8 | 11 | 120.0 | L | CL | A4 (6) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 2E | 3(TE) | 4(TE) | 5(TE) | 6T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate rapid (5-15 cm/hr) |
| Compressibility | Moderate | Permeability-compacted | Low |
| Corrosion potential | Moderate | Shear rate | |
| Erodibility-topsoil | High (K = .39) | Shrink-swell potential | Moderate |
| Erodibility-subsoil | High (K = .57) | Slope range | .5 - 100% |
| Flooding hazard | Low (none) | Slope stability | Stable |
| Frost heave potential | Moderate-high (F3-F4) | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Fair-poor | Thickness of Ah, slope |
| Source of sand | Very poor-poor | Unified soil group (CL-SP), depth to sand |
| Source of gravel | Very poor-poor | Unified soil group (CL-SP), irregular gravel lenses |
| Source of roadfill | Fair | Shrink-swell AASHO |
| Road location | Moderate | Shrink-swell, AASHO, slope |
| Permanent buildings | Moderate | Slope, shrink-swell, frost action |
| Shallow excavations | Slight | No significant limitations except slope |
| Septic tank absorption fields | Moderate-severe | Depth to sand, slope |
| Sanitary landfills | Moderate-severe | Moderately rapid permeability, depth to sand or gravel |
| Reservoir areas | Severe | Moderately rapid permeability, slope |
| Camp areas | Slight | No significant limitations except slope |
| Picnic areas | Slight | No significant limitations except slope |
| Paths and trails | Slight | No significant limitations except slope |

## Appendix A. (continued)

**Soil Series:** Sharp Hill (Taxadjunct) **Series Symbol:** No series symbol **Sampled Soil Unit:** ADHP 3

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 479 hectares, 0.20% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Ridged morainal and glaciofluvial
**Drainage:** Well to rapidly drained
**Parent Material:** Coarse loamy till and glaciofluvial mixed
**Comments:** Sandy subsoil has appearance of good till. Orthic Black equivalent of Sharp Hill soil.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 16 (¼ SEC) 26 (TWP) 29 (R) W4 (M) **Sampled by:** RM **Sample date:** Nov. 1980

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ap | 12 | 10YR 3/2m | loam | moderate, medium granular | friable, moist | abrupt smooth | 1% |
| Bm | 24 | 10YR 4/3m | loam | weak, coarse, prismatic + moderate, coarse platy | slightly hard-hard dry, friable, moist | abrupt smooth | 10% |
| Cca | 37 | 10YR 6/2d<br>10YR 5/3m | sandy loam - sandy clay loam | pseudo-platy | hard, dry, friable, moist | gradual smooth | 10% |
| Ck | | 10YR 6/3m | sandy loam | amorphous | slightly hard-soft, dry, very friable, moist | | 2% |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | 7.2 | 0.23 | 2.68 | 12 | | | | | | | 42 | 40 | 18 | L | |
| Bm | 7.2 | 0.13 | 1.22 | 9 | | | | | | | 33 | 47 | 20 | L | |
| Cca | 7.6 | | | | 28.41 | | | | | | - | - | - | | |
| Ck | 7.7 | | | | 16.46 | | | | | | 62 | 25 | 13 | SL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 98 | 96 | 91 | 45 | 55 | 26 | 19 | 17 | 16 | 1 | 12 | 117.5 | SL | SC | A4 (2) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | | | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | | Permeability-unaltered | |
| Compressibility | | Permeability-compacted | |
| Corrosion potential | | Shear strength | |
| Erodibility-topsoil | | Shrink swell potential | |
| Erodibility-subsoil | | Slope range | |
| Flooding hazard | | Slope stability | |
| Frost heave potential | | Workability of material | |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | | |
| Source of sand | | |
| Source of gravel | | |
| Source of roadfill | | |
| Road location | | |
| Permanent buildings | | |
| Shallow excavations | | |
| Septic tank absorption fields | | |
| Sanitary landfills | | |
| Reservoir areas | | |
| Camp areas | | |
| Picnic areas | | |
| Paths and trails | | |

# Appendix A. (continued)

**Soil Series:** Spruce Ridge **Series Symbol:** SPR **Sampled Soil Unit:** SPR 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 9973 hectares, 4.20% of total area
**Classification:** Orthic Gray Luvisol (CSSC 78) Typic Cryoboralf (soil taxonomy)
**Landforms:** Morainal blanket to veneer over ridged rock
**Drainage:** Well drained, rapid surface runoff
**Parent Material:** Stony clay loam till
**Comments:** Very stony till. Typical of foothills region tills.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NW 8 (¼ SEC) 22 (TWP) 4 (R) W5 (M) **Sampled by:** RM **Sample date:** Aug. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| LH | (4-0) | | | | | | |
| Ae | 15 | 7.5YR 4/4 | fine sandy loam | weak-moderate fine-medium platy | very friable to friable (moist) | clear smooth | 15% |
| Bt | 90 | 10YR 3/3 (peds) 10YR 4/3(D) | clay loam-sandy clay loam | moderate fine - medium subangular blocky | firm (moist) | abrupt smooth | 20-30% |
| Ck | - | 10YR 3/3 | clay loam to sandy clay loam | amorphous | firm (moist) | firm (moist) | 20-30% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | 6.0 | 1.30 | 20.36 | 16 | - | 0.09 | 2.40 | 59.27 | 9.05 | 75.6 | - | - | - | | |
| Ae | 4.2 | .16 | 2.08 | 13 | - | 0.01 | 0.26 | 5.16 | 1.59 | 14.4 | 22 | 60 | 18 | SiL | |
| Bt | 4.8 | .10 | 1.38 | 14 | - | 0.07 | 0.38 | 13.31 | 4.25 | 24.7 | 21 | 41 | 38 | SiCL | |
| Ck | 7.0 | - | - | - | 5.3 | - | - | - | - | - | 23 | 46 | 31 | CL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 72 | 71 | 70 | 42 | 30 | 41 | 29 | 32 | 18 | 14 | 17 | 107.5 | CL | GC-CL | A6 (3) |
| Ave. of 16 profiles | | | | | 31 | 41 | 28 | 35 | 20 | 15 | | | CL-L | GC-CL | A6 (3) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

**CLI Capability for Agriculture**

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | | 5C | 5C | 6T | 6T |

**Estimated Yields of Common Crops**

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

**Estimated Engineering Behavior (Design Considerations)**

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate-slow (.5 - 1.5) |
| Compressibility | Low-moderate | Permeability-compacted | Low |
| Corrosion potential | Low-moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | High (K = .45) | Shrink-swell potential | Low-moderate |
| Erodibility-subsoil | High (K = .40) | Slope range | 10 - 45 |
| Flooding hazard | None | Slope stability | Generally good |
| Frost heave potential | Moderate-high (F3-F4) | Workability of material | Good-fair |

**Suitabilities and Limitations for Selected Uses**

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Very poor | No Ah horizon |
| Source of sand | Very poor | Unified soil group (GC-CL), soil texture (CL) |
| Source of gravel | Very poor | Unified soil group (GC-CL), soil texture (CL) |
| Source of roadfill | Fair-poor | Frost heave, slope, shrink-swell |
| Road location | Fair-poor | Frost heave, slope, shrink-swell |
| Permanent buildings | Moderate | Frost heave, depth to bedrock, slope |
| Shallow excavations | Moderate-severe | Texture (CL), depth to bedrock, stoniness, slope |
| Septic tank absorption fields | Severe-very severe | Permeability, depth to bedrock, slope |
| Sanitary landfills | Moderate-severe | Soil texture (CL), depth to bedrock, stoniness, slope |
| Reservoir areas | Moderate-severe | Depth to bedrock, coarse fragments, slope |
| Camp areas | Moderate-very severe | Slope, permeability |
| Picnic areas | Moderate-very severe | Slope, stoniness, surface texture |
| Paths and trails | Moderate-severe | Slope, stoniness, surface texture |

# Appendix A. (continued)

**Soil Series:** Spy Hill **Series Symbol:** SPY **Sampled Soil Unit:** SPY 2

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 6929 hectares, 2.91 % of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Hummocky moraine
**Drainage:** Well drained component, deranged drainage pattern
**Parent Material:** Fine loamy to fine silty till
**Comments:** Stony till on hummocky landscape.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 31 (¼ SEC) 25 (TWP) 3 (R) W5 (M) **Sampled by:** RM **Sample date:** Aug. 1980

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 10 | 10YR 3/1d<br>10YR 2/1m | loam | moderate, fine, granular | friable, boist, soft dry | clear wavy | 0 |
| Bm | 26 | 10YR 4/2d | clay loam | weak-moderate, medium coarse prismatic and weak-moderate fine sub-angular blocky | slightly hard, dry friable, moist | gradual smooth | 2% |
| Bmk | 48 | 10YR 5/2d | clay loam | moderate, fine, subangular blocky | slightly hard, dry | gradual smooth | 4% |
| Cca | 76 | 10YR 7/1d<br>10YR 5/3d | loam | amorphous | hard, dry | gradual smooth | 20% |
| Ck | | 10YR 7/1d<br>10YR 5/3d | loam | amorphous | hard, dry | | 30% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.7 | 0.18 | 9.02 | 50 | | 0.04 | 2.22 | 40.41 | 8.81 | 58.4 | 11 | 53 | 43 | SiC | |
| Bm | 7.2 | 0.23 | 3.67 | 16 | | 0.06 | 0.60 | 28.84 | 8.81 | 40.8 | 11 | 32 | 57 | C | |
| Bmk | 7.5 | 0.12 | 1.55 | 13 | 21.01 | 0.03 | 0.34 | 44.63 | 7.28 | 22.8 | 13 | 40 | 47 | SiC | |
| Cca | 7.6 | | | | 24.60 | | | | | | - | - | - | | |
| Ck | 7.8 | | | | 33.64 | | | | | | 25 | 41 | 31 | CL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 80 | 76 | 72 | 48 | 33 | 37 | 30 | 31 | 18 | 13 | 17 | 107.5 | CL | SC-CL | A6 (4) |
| Ave. of 18 profiles | | | | | 20 | 48 | 32 | 39 | 24 | 15 | | | CL-SiCL | CL-SC | A6 (5) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 3C | 3C | 4T | 5T | 6T |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Fair-good | Permeability-unaltered | Moderate slow (.5-1.5 cm/hr) |
| Compressibility | Low-moderate | Permeability-compacted | Moderate-low |
| Corrosion potential | Moderate-low | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .23) | Shrink-swell potential | Low-moderate |
| Erodibility-subsoil | High (K = .40) | Slope range | 9 - 100% |
| Flooding hazard | None | Slope stability | |
| Frost heave potential | Moderate-high (F3-F4) | Workability of material | Good-fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thickness of Ah, slope |
| Source of sand | Poor-very poor | Unified soil group (CL-SM), depth to sand or gravel |
| Source of gravel | Poor-very poor | Unified soil group (CL-SM), depth to sand or gravel |
| Source of roadfill | Fair | Frost action, shrink-swell, stoniness, slope |
| Road location | Moderate | Frost action, shrink-swell, stoniness, slope |
| Permanent buildings | Moderate | Frost action, slope, stoniness |
| Shallow excavations | Moderate-severe | Texture (CL), slope, stoniness |
| Septic tank absorption fields | Severe-very severe | Permeability, slope |
| Sanitary landfills | Moderate | Texture, stoniness, slope |
| Reservoir areas | Moderate | Coarse fragments, slope |
| Camp areas | Moderate-very severe | Permeability, stoniness, slope, surface texture |
| Picnic areas | Moderate-very severe | Permeability, stoniness, slope, surface texture |
| Paths and trails | Slight-very severe | Permeability, stoniness, slope, surface texture |

# Appendix A. (continued)

**Soil Series:** Sarcee **Series Symbol:** SRC **Sampled Soil Unit:** SRC 2

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 5260 hectares, 2.20% of total area
**Classification:** Orthic Black (CSSC 78) Udic Haploboroll (soil taxonomy)
**Landforms:** Recent fluvial terrace
**Drainage:** Well to rapidly drained, central drainage channel
**Parent Material:** Fine loamy recent fluvial (alluvium)
**Comments:** Exposed channel bank shows gravel at 1.5 meters.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 2 (¼ SEC) 22 (TWP) 3 (R) W5 (M) **Sampled by:** RM & PTS **Sample date:** Aug. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 20 | 10YR 2/2m<br>10YR 3/2d | fine sandy loam | strong medium granular | very friable (moist) | clear smooth | 0 |
| Bm | 35 | 10YR 3/3m | sandy loam | amorphous | very friable (moist) | abrupt smooth | 0 |
| Ck | - | 10YR 3/3-4/3 | sandy loam - loamy sand | amorphous | very friable (moist) | | 0 |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.9 | .41 | 4.71 | 11 | - | .05 | .63 | 27.68 | 5.64 | 35.1 | 27 | 44 | 29 | | |
| Bm | 7.4 | .15 | 2.06 | 14 | - | - | - | - | - | - | 31 | 44 | 25 | | |
| Ck | 7.6 | - | - | - | 6.5 | - | - | - | - | - | 34 | 42 | 24 | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | - | - | 99 | 42 | 45 | 28 | 27 | 33 | 20 | 13 | 20 | 102.5 | L | SC | A6 (3) |
| Ave. of 12 profiles | | | | | 24 | 56 | 20 | 29 | 20 | 9 | | | CL | SC-CL | A4 (3) |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

**CLI Capability for Agriculture**

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | - | 3C | 4(TI)<br>4(WI) | | | |

**Estimated Yields of Common Crops**

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

**Estimated Engineering Behavior (Design Considerations)**

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good-fair | Permeability-unaltered | Moderate rapid (5-15 cm/hr) |
| Compressibility | Low-moderate | Permeability-compacted | Low |
| Corrosion potential | Low-moderate | Shear strength | Moderate-low |
| Erodibility-topsoil | Moderate (K = .31) | Shrink-swell potential | Low |
| Erodibility-subsoil | High (K = .41) | Slope range | .5 - 15 |
| Flooding hazard | Moderate-high (infrequent-frequent) | Slope stability | NA |
| Frost heave potential | Moderate (F2-F3) | Workability of material | Good |

**Suitabilities and Limitations for Selected Uses**

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Good-fair | Texture (FSL), thickness of Ah, flooding hazard |
| Source of sand | Poor-fair | Unified soil group (SC) |
| Source of gravel | Very poor | Unified soil group (SC) |
| Source of roadfill | Good-fair | Flooding hazard, frost heave |
| Road location | Slight-moderate | Flooding hazard, frost heave |
| Permanent buildings | Moderate-severe | Flooding hazard, frost heave |
| Shallow excavations | Slight | Severe in location subject to flooding |
| Septic tank absorption fields | Slight-moderate | Possible groundwater contamination hazard |
| Sanitary landfills | Severe | Flooding hazard, rapid permeability, groundwater contamination |
| Reservoir areas | Moderate-severe | Flooding hazard, rapid permeability |
| Camp areas | Slight-moderate | Flooding hazard |
| Picnic areas | Slight-moderate | Flooding hazard |
| Paths and trails | Slight-moderate | Flooding hazard |

# Appendix A. (continued)

**Soil Series:** Sundre **Series Symbol:** SUD **Sampled Soil Unit:** SUD 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 492 hectares, 0.20% of total area
**Classification:** Orthic Dark Gray (CSSC 78) Boralfic Haploboroll (soil taxonomy)
**Landforms:** Glaciofluvial terrace; level to undulating
**Drainage:** Rapidly to very rapidly drained, abandoned braided channels
**Parent Material:** Loamy skeletal to sandy skeletal glaciofluvial (gravels)
**Comments:** Well-rounded, well-sorted, outwash gravels under forest vegetation.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 18 (¼ SEC) 24 (TWP) 3 (R) W5 (M) **Sampled by:** RM **Sample date:** May 1978

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahe | 12 | 10YR 2/1m<br>10YR 3/1d | loam | weak fine granular | very friable (moist) | clear smooth | 2% |
| Bm | 23 | 10YR 3/3m<br>10YR 4/3d | sandy loam | single grain | very friable (moist) | clear smooth | 2% |
| Cca | 55 | 10YR 7/2d (lime)<br>10YR 5/2d (sand) | gravel and sand | single grain | loose (dry) | diffuse smooth | 80% |
| Ck | - | 10YR 3/4m<br>10YR 5/2d | gravel and sand | single grain | loose (dry) | | |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahe | 7.7 | 0.71 | 8.51 | 12 | - | - | - | - | - | - | 26 | 50 | 24 | SiL-L | |
| Bm | 7.8 | 0.11 | 6.04 | - | - | - | - | - | - | - | 31 | 59 | 10 | SiL | |
| Cca | 7.8 | - | - | - | 49.3 | - | - | - | - | - | 58 | 28 | 14 | SL | |
| Ck | 7.7 | - | - | - | 51.0 | - | - | - | - | - | - | - | - | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 29 | 19 | 18 | 10 | 24 | 36 | 40 | 20 | 17 | 3 | 14 | 112.5 | GV-CL | GP-GC | A-2-4 (0) |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | 4(MP) | 4(MP) | | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Rapid (15-50 cm/hr) |
| Compressibility | Low-moderate | Permeability-compacted | High |
| Corrosion potential | Low-moderate | Shear strength | High |
| Erodibility-topsoil | Moderate (K = .21) | Shrink-swell potential | Low |
| Erodibility-subsoil | Moderate (K = .27) | Slope range | 0 - 5% |
| Flooding hazard | Moderate (occasional) | Slope stability | |
| Frost heave potential | Low-moderate (F1-2) | Workability of material | Good |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thickness of Ah, flooding hazard, stoniness |
| Source of sand | Poor | Unified soil group (GP-GC) |
| Source of gravel | Good-fair | Seasonally high water table |
| Source of roadfill | Good | Seasonally high water table |
| Road location | Slight-moderate | Flooding hazard |
| Permanent buildings | Moderate-severe | Occasional flooding, stoniness |
| Shallow excavations | Severe | Gravelly soil, stoniness |
| Septic tank absorption fields | Severe | Rapid permeability, groundwater contamination hazard |
| Sanitary landfills | Very severe | Rapid permeability, groundwater contamination hazard |
| Reservoir areas | Severe | Permeability, unified soil group (GP-GC) |
| Camp areas | Moderate-severe | Flooding hazard, surface stoniness |
| Picnic areas | Moderate | Flooding hazard, surface stoniness |
| Paths and trails | Moderate | Flooding hazard, surface stoniness |

# Appendix A. (continued)

**Soil Series:** Tweedsmuir (Taxadjunct) **Series Symbol:** no series symbol **Sampled Soil Unit:** TWS 2

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1905 hectares, 0.79% of total area
**Classification:** Rego BLack (CSSC 78) Entic Udic Haploboroll (soil taxonomy)
**Landforms:** Level to undulating recent fluvial flood plain, dissected
**Drainage:** Well to rapidly drained, central drainage channel
**Parent Material:** Fine silty recent fluvial
**Comments:** Similar to Tweedsmuir except for presence of lime to surface and absence of Bm horizon.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 32 (¼ SEC) 21 (TWP) 1 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahk | 30 | 10YR 2/1m<br>10YR 2/1d | loam | medium granular | very friable | clear smooth | 0% |
| Ckg | | 2.5Y 3/2 | fine sandy loam - silt loam | amorphous (bedded) | very friable | | 0% |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahk | 8.4 | .53 | 8.64 | 16 | 14.2 | - | - | - | - | - | 6 | 60 | 34 | SiCL | |
| Ckg | 7.8 | - | - | - | 22.8 | - | - | - | - | - | 10 | 67 | 23 | SiL | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | | | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | | Permeability-unaltered | |
| Compressibility | | Permeability-compacted | |
| Corrosion potential | | Shear strength | |
| Erodibility-topsoil | | Shrink-swell potential | |
| Erodibility-subsoil | | Slope range | |
| Flooding hazard | | Slope stability | |
| Frost heave potential | | Workability of material | |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | | |
| Source of sand | | |
| Source of gravel | | |
| Source of roadfill | | |
| Road location | | |
| Permanent buildings | | |
| Shallow excavations | | |
| Septic tank absorption fields | | |
| Sanitary landfills | | |
| Reservoir areas | | |
| Camp areas | | |
| Picnic areas | | |
| Paths and trails | | |

# Appendix A. (continued)

**Soil Series:** Twin Bridges **Series Symbol:** TBR **Sampled Soil Unit:** TBR 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 1640 hectares, 0.69% of total area
**Classification:** Orthic Humic Regosol (CSSC 78) Mollic Fluvaquent (soil taxonomy)
**Landforms:** Level to undulating, recent fluvial flood plain
**Drainage:** Moderately well to imperfectly drained, central drainage channel
**Parent Material:** Coarse loamy glaciofluvial and recent fluvial
**Comments:** Sampled on river flats. Very weakly developed Ah horizon.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 5 (¼ SEC) 24 (TWP) 2 (R) W5 (M) **Sampled by:** RM **Sample date:** May 1978

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahjk | 12 | 10YR 3/2m to 3/3m | sandy loam - loam | strong medium granular | very friable-friable | gradual smooth | 0 |
| Ck | 75 | 10YR 3/3m to 2.5Y 4/2m | loamy sand - sandy loam | amorphous single grain | very friable | gradual smooth | 0 |
| Ckg | - | 10YR 3/3m to 2.5Y 4/2m wet | sandy loam - loamy sand | amorphous single grain | very friable | | 0 |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahjk | 7.5 | 0.20 | 6.56 | - | - | - | - | - | - | - | 29 | 55 | 16 | SiL | |
| Ck | 7.5 | - | - | - | 42.4 | - | - | - | - | - | 34 | 55 | 11 | SiL | |
| Ckg | 7.6 | - | - | - | 42.0 | - | - | - | - | - | - | - | - | | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | 100 | 100 | 97 | 39 | 61 | | | | | | | | | | |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

**CLI Capability for Agriculture**

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 5(IW) | 5(IW) | | | |

**Estimated Yields of Common Crops**

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

**Estimated Engineering Behavior (Design Considerations)**

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Moderately rapid (5 - 15) |
| Compressibility | Low-moderate | Permeability-compacted | Moderate-high |
| Corrosion potential | Low | Shear strength | Moderate |
| Erodibility-topsoil | Moderate (K = .32) | Shrink-swell potential | Low-moderate |
| Erodibility-subsoil | High (K = .56) | Slope range | 2 - 10 |
| Flooding hazard | Frequent | Slope stability | |
| Frost heave potential | Low (F1) | Workability of material | Fair |

**Suitabilities and Limitations for Selected Uses**

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Loose consistency, occasional flooding, thin Ah |
| Source of sand | Poor | Seasonally high water table, flooding |
| Source of gravel | Poor | Seasonally high water table, flooding |
| Source of roadfill | Fair | Flooding, seasonally high water table |
| Road location | Moderate | Flooding, seasonally high water table |
| Permanent buildings | Severe | Flooding |
| Shallow excavations | Severe | Texture at depth to be excavated (S), flooding |
| Septic tank absorption fields | Severe | Flooding, groundwater contamination hazard |
| Sanitary landfills | Severe | Permeability, seasonally high water table, groundwater contamination hazard |
| Reservoir areas | Severe | Permeability, flooding |
| Camp areas | Moderate | Flooding, seasonally high water table |
| Picnic areas | Moderate | Flooding, seasonally high water table |
| Paths and trails | Moderate | Flooding, seasonally high water table |

## Appendix A. (continued)

**Soil Series:** Unnamed Gleysol **Series Symbol:** **Sampled Soil Unit:** TWS 2

### GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:**
**Classification:** Rego Humic Gleysol (CSSC 78) Calcic Aquoll (soil taxonomy)
**Landforms:** Level to undulating fluvial flood plain
**Drainage:** Poorly drained, central drainage channel
**Parent Material:** Coarse loamy recent fluvial
**Comments:** Sandier than most soils in TWS units.

### DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** NE 24 / ¼ SEC — 21 / TWP — 1 / R — W5 / M **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ahkg | 25 | 10YR 2/1 | loam | amorphous | very friable | gradual smooth | 0 |
| ACkg | 56 | 5Y 2/1 | loam, sandy loam, silt loam | single grain | very friable (moist) nonsticky - non-plastic (wet) | clear smooth | 0 |
| Ckg | | 5Y 5/1 | sand, sandy loam, loamy sand | single grain | nonsticky - non-plastic (wet | | 0 (all sand) |

### CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahkg | 7.7 | .76 | 0.46 | 12 | 7.7 | - | - | - | - | - | 35 | 39 | 26 | SiL | |
| ACkg | 7.8 | .41 | 6.69 | 16 | 11.5 | - | - | - | - | - | 56 | 31 | 13 | SL | |
| Ckg | 8.1 | - | - | - | 12.4 | - | - | - | - | - | 59 | 31 | 10 | SL | |

### PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of 2 profiles | | | | | 34 | 49 | 16 | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | 4(WI) | 4(WI) | 4(WI) | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | | Permeability-unaltered | |
| Compressibility | | Permeability-compacted | |
| Corrosion potential | | Shear strength | |
| Erodibility-topsoil | High (K = .38) | Shrink-swell potential | |
| Erodibility-subsoil | High (K = .43) | Slope range | 2 - 10% |
| Flooding hazard | Moderate (infrequent-occasional) | Slope stability | |
| Frost heave potential | | Workability of material | |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Good-fair | Flooding, surface texture |
| Source of sand | Very poor | Unified soil group |
| Source of gravel | Very poor | Unified soil group |
| Source of roadfill | Fair | Frost heave, shrink swell |
| Road location | Moderate | Flooding, frost heave, shrink-swell |
| Permanent buildings | Severe | Occasional flooding |
| Shallow excavations | Moderate-severe | Seasonally high water table, flooding |
| Septic tank absorption fields | Severe | Occasional flooding |
| Sanitary landfills | Moderate-severe | Occasional flooding |
| Reservoir areas | Severe | Subject to flooding |
| Camp areas | Moderate | Flooding hazard, surface texture |
| Picnic areas | Moderate | Flooding hazard, surface texture |
| Paths and trails | Moderate | Flooding hazard, surface texture |

# Appendix A. (continued)

**Soil Series:** Wilson **Series Symbol:** WSN **Sampled Soil Unit:** MD-L 1

## GENERAL CHARACTERISTICS

**Approximate soil unit extent in survey area:** 251 hectares, 0.10% of total area
**Classification:** Orthic Black, Lithic phase (CSSC 78) Lithic Udic Haploboroll (soil taxonomy)
**Landforms:** Glaciofluvial veneer over bevelled rock terrace
**Drainage:** Well to rapidly drained, no surface drainage features
**Parent Material:** Coarse loamy glaciofluvial (or residual) veneer over rock
**Comments:** Sandy material may have weathered from sandstone in place.

## DESCRIPTION AND ANALYSES OF A REPRESENTATIVE PROFILE

**Profile Location:** SE 24 (¼ SEC) 21 (TWP) 1 (R) W5 (M) **Sampled by:** RM **Sample date:** Oct. 1977

**Description of Representative Profile:**

| Horizon | Depth (cm) | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 13 | 10YR 2/1 | loam | fine granular | very friable (moist) soft (dry) | clear wavy | 0 |
| Bm | 50 | 10YR 4/4 | silt loam | moderate medium prismatic | slightly hard (dry) very friable (moist) | clear smooth | 0 |
| Ck | 60 | 2.5Y 7/2d 2.5Y 5/4m | sandy loam | - | very friable (moist) loose (dry) | abrupt wavy | 15% ss.frag. |
| R | - | | (soft ss.frag.) | | | | |

## CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILE

| Horizon | pH $CaCl_2$ | N % | Organic C% | C/N | %$CaCO_3$ Equivalent | Exchangeable Cations (meq/100 g) Na | K | Ca | Mg | CEC (meq/100 g) | USDA Separates %S | %Si | %C | USDA Texture | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 6.2 | 0.55 | 9.17 | 17 | - | .05 | 1.58 | 35.83 | 5.98 | 41.3 | 17 | 57 | 26 | SiL | |
| Bm | 6.4 | 0.12 | 1.50 | 13 | - | .04 | .72 | 16.84 | 3.33 | 20.1 | 11 | 61 | 28 | SiL | |
| Ck | 7.4 | - | - | - | 15.8 | - | - | - | - | - | 47 | 40 | 13 | L | |

## PHYSICAL ANALYSIS OF C HORIZON (S)

| Data Source | % Passing Sieve #4 | #10 | #40 | #200 | USDA Separates %S | %Si | %C | Liquid limit | Plastic limit | Plasticity index | Optm. Moist. | Est. Proctor Density | Classification USDA | UNIFIED | AASHO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Described profile | | | | | | | | | | | | | | | |
| Ave. of profiles | | | | | | | | | | | | | | | |

## Appendix A. (continued)

### AGRICULTURAL INTERPRETATIONS

#### CLI Capability for Agriculture

| Slope Class | A | bBC | cD | dE | eF | f and larger |
|---|---|---|---|---|---|---|
| CLI Rating | | 3M | 4(MT) | | | |

#### Estimated Yields of Common Crops

| Kilograms/ha | Wheat | Oats | Barley | Rapeseed |
|---|---|---|---|---|
| Fallow | | | | |
| Stubble | | | | |

### NON-AGRICULTURAL (PEDOTECHNICAL) INTERPRETATIONS

#### Estimated Engineering Behavior (Design Considerations)

| Behavior | Rating | Behavior | Rating |
|---|---|---|---|
| Compaction | Good | Permeability-unaltered | Moderate |
| Compressibility | Low-moderate | Permeability-compacted | Moderate-high |
| Corrosion potential | Low | Shear strength | Moderate |
| Erodibility-topsoil | Moderate (K = .22) | Shrink-swell potential | Low-moderate |
| Erodibility-subsoil | High (K = .58) | Slope range | .5 - 9% |
| Flooding hazard | None | Slope stability | |
| Frost heave potential | Low | Workability of material | Fair |

#### Suitabilities and Limitations for Selected Uses

| Item | Rating | Reason(s) for Rating |
|---|---|---|
| Source of topsoil | Poor | Thickness of Ah horizon |
| Source of sand | Poor | Unified soil group (SM), depth to bedrock |
| Source of gravel | Very poor | Unified soil group (SM), no gravel |
| Source of roadfill | Fair | Depth to bedrock |
| Road location | Moderate | Depth to bedrock |
| Permanent buildings | Moderate-severe | Depth to bedrock |
| Shallow excavations | Severe | Depth to bedrock |
| Septic tank absorption fields | Severe | Depth to bedrock |
| Sanitary landfills | Very severe | Depth to bedrock |
| Reservoir areas | Severe | Depth to bedrock |
| Camp areas | None-slight | No significant limitations except slope |
| Picnic areas | None-slight | No significant limitations except slope |
| Paths and trails | None-slight | No significant limitations except slope |

# Appendix B. Soil climate data for six sites within the map area.

## Data Pertaining to Soil Climate Monitoring Site C1

### SITE DESCRIPTION

1. Location: SW 10-24-28-W4
2. Elevation: 1036 m (3400 feet)
3. Topography: Inclined to gently rolling, 5 to 9% slope
4. Drainage: Well drained
5. Aspect: Slight SW aspect
6. Landform: Undulating to gently rolling morainal, crest position
7. Map unit: DEL 1
8. Soil series: Delacour
9. Parent material: Till (Continental)
10. Classification: Orthic Black
11. Comments: Near AES, Chestermere Lake climate station

### DESCRIPTION AND ANALYSES OF SOIL PROFILE

#### Profile Description

| Horizon | Depth | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| F | 0 | 10YR 3/3d | fibrous grass roots | - | - | clear smooth | 0 |
| Ap | 20 | 10YR 2/1m 10YR 3/2d | SiL | strong fine-medium granular | very friable-moist soft-dry | abrupt smooth | 0 |
| $Bm_1$ | 35 | 10YR 3/3m ped surface | CL | strong, medium-coarse, prismatic and moderate, fine, subangular blocky | friable-moist | abrupt smooth | 1-2 |
| $Bm_2$ | 50 | 10YR 4/3m ped | CL | strong, medium-coarse, prismatic and moderate, fine, subangular blocky | friable-moist | abrupt smooth | 1-2 |
| Cca | 75+ | 2.5Y 4/2m 10YR 6/2d | CL | amorphous | friable-moist slightly hard-dry | diffuse smooth | 2-5 |
| Ck | | 2.5Y 4/2m | | amorphous | friable-moist slightly hard-dry | - | 3-5 |

#### Chemical Analysis

| Horizon | pH | | N | Organic | | % $CaCO_3$ | Exchangeable cations (meq/100 g) | | | | Total CEC | USDA Separates | | | USDA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | Ca | % | C % | C/N | Equivalent | Na | K | Ca | Mg | (meq/100 g) | % Sand | % Silt | % Clay | Texture |
| F | 6.2 | 5.6 | - | 21.56 | - | - | - | - | - | - | - | - | - | - | - |
| Ap | 6.3 | 5.7 | 0.37 | 5.49 | 15 | - | 0.08 | 3.89 | 14.81 | 4.62 | 16.5 | 24 | 52 | 24 | SiL |
| $Bm_1$ | 6.0 | 5.6 | 0.12 | 1.30 | 11 | - | 0.05 | 2.15 | 9.78 | 4.51 | 12.7 | 31 | 36 | 33 | CL |
| $Bm_2$ | 6.6 | 6.1 | 0.09 | 1.10 | 12 | - | 0.07 | 1.24 | 10.22 | 3.95 | 8.7 | 32 | 37 | 31 | CL |
| Cca | 8.0 | 7.5 | - | - | - | 11.48 | - | - | - | - | - | 33 | 39 | 28 | CL |
| Ck | 7.9 | 7.7 | - | - | - | 9.39 | - | - | - | - | - | - | - | - | - |

#### Additional Analysis

| Horizon | Liquid Limit | Plastic Limit | Plasticity Index | Field $\theta$ (%) | $\theta$ Sat. (%) | % Sat at Field $\theta$ | Bulk Density Dry 105°C | K Sat Ave (cm/hr) | $\theta$ (%) at $\psi$ (ATM) 1/3 | 1 | 3 | 7 | 15 | Percolation Rate (Auger Hole) (min./inch) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | 45 | 35 | 10 | 12.7 | 54.4 | 23.0 | 1.02 | 3.94 | 40 | 23 | 17 | 16 | 18 | |
| Bm | 45 | 24 | 21 | 11.8 | 37.0 | 32.2 | 1.37 | 10.67 | 27 | 22 | 20 | 18 | 18 | 31 (4.9)* |
| Ck | 35 | 17 | 18 | 8.3 | 27.1 | 29.9 | 1.61 | 2.20 | 23 | 17 | 14 | 12 | 11 | |

# Appendix B. (continued)

## SOIL CLIMATE DATA

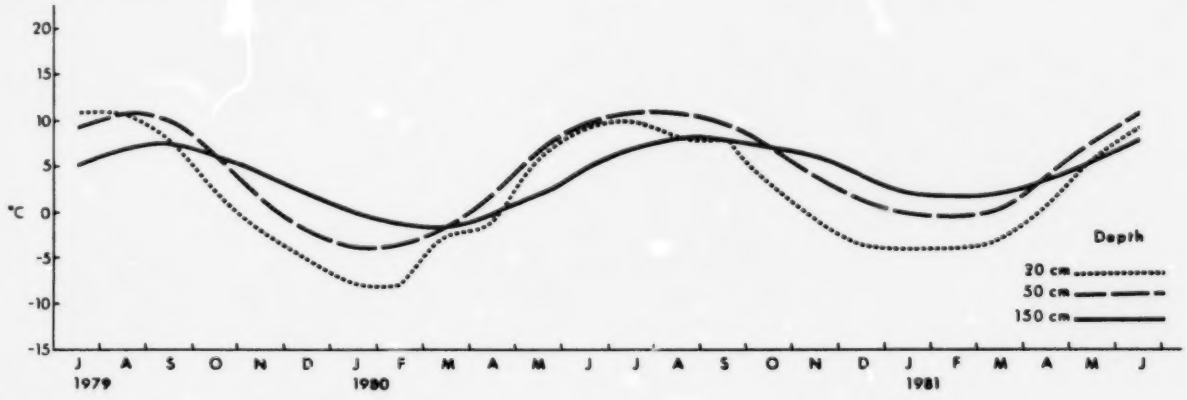
### Soil Temperature

| | | 1979 | | | | | | 1980 | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| (°C) | 10 | 12 | 12 | 10 | 2 | -3 | -6 | -5 | -5 | -1 | -1 | 11 | 13 | 15 | 14 | 12 | 6 | 1 | -4 | -3 | -1 | 0 | 3 | 8 | 12 |
| | 20 | 11 | 11 | 8 | 2 | -2 | -5 | -8 | -8 | -2 | -1 | 6 | 9 | 10 | 8 | 8 | 3 | -1 | -4 | -4 | -4 | -3 | 1 | 6 | 9 |
| | 50 | 9 | 11 | 10 | 6 | 1 | -2 | -4 | -4 | -2 | 2 | 7 | 10 | 11 | 11 | 10 | 7 | 4 | 1 | 0 | 0 | 0 | 4 | 8 | 11 |
| | 100 | 6 | 9 | 8 | 6 | 3 | 1 | -2 | -2 | -2 | 0 | 4 | 6 | 8 | 9 | 7 | 6 | 4 | 2 | 0 | 0 | 0 | 4 | 6 | 8 |
| | 150 | 5 | 7 | 8 | 6 | 4 | 2 | 0 | -1 | -2 | 0 | 2 | 5 | 7 | 8 | 8 | 7 | 6 | 4 | 2 | 2 | 2 | 4 | 6 | 8 |

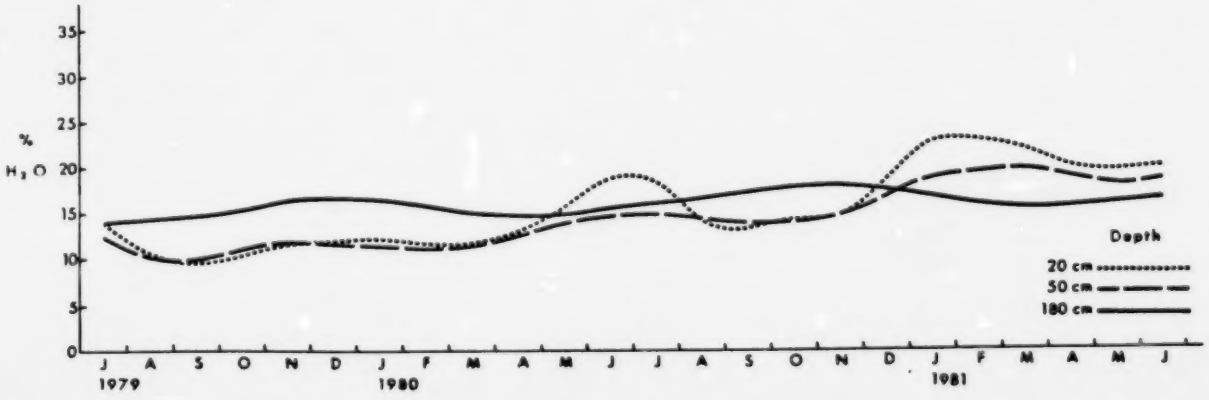
### Soil Moisture

| | | 1979 | | | | | | 1980 | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| % $H_2O$ | 20 | 14 | 10 | 9 | 10 | 12 | 12 | 12 | 12 | 11 | 13 | 15 | 19 | 18 | 14 | 13 | 14 | 14 | 19 | 23 | 23 | 22 | 20 | 20 | 20 |
| by volume | 50 | 13 | 11 | 10 | 11 | 12 | 12 | 12 | 11 | 10 | 13 | 14 | 15 | 15 | 14 | 14 | 14 | 14 | 17 | 19 | 19 | 20 | 19 | 18 | 19 |
| | 100 | 16 | 14 | 13 | 13 | 14 | 14 | 15 | 14 | 13 | 13 | 13 | 14 | 14 | 15 | 15 | 16 | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 17 |
| | 180 | 14 | 15 | 15 | 15 | 17 | 17 | 17 | 16 | 15 | 15 | 15 | 16 | 16 | 16 | 17 | 18 | 18 | 17 | 17 | 16 | 16 | 16 | 16 | 16 |

### Soil Temperature Changes with Depth Over Time




### Soil Moisture Changes with Depth Over Time



# Appendix B. (continued)

## Data Pertaining to Soil Climate Monitoring Site C2

### SITE DESCRIPTION

1. Location: SW 18-26-2-W5
2. Elevation: 1265 m
3. Topography: Undulating, 3 to 5% slope
4. Drainage: Well drained
5. Aspect: Not significant
6. Landform: Undulating morainal blanket over flat lying bedrock
7. Map unit: DVG 1
8. Soil series: Dunvargan
9. Parent material: Till (mixed origin, mostly Cordilleran)
10. Classification: Orthic Black
11. Comments: Gravelly lens at contact of Bm/Cca

### DESCRIPTION AND ANALYSES OF SOIL PROFILE

#### Profile Description

| Horizon | Depth | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ap | 24 | 10YR 2/2d<br>10YR 2/1m | SiL | strong coarse granular | slightly hard-dry | clear smooth friable-moist | 1 |
| Bm | 55 | 10YR 3/3d<br>10YR 4/4m | CL | weak medium-coarse prismatic | slightly hard-dry friable-moist | abrupt smooth | 3 |
| Cca | 95 | 10YR 6/2d<br>10YR 5/3m | CL | amorphous | soft-dry friable-moist | gradual smooth | 15-20 |
| Ck | | 10YR 5/3m | CL | pseudo platy | soft-dry friable-moist | | 10 |

#### Chemical Analysis

| Horizon | pH | | N | Organic | | % $CaCO_3$ | Exchangeable cations (meq/100 g) | | | | Total CEC | USDA Separates | | | USDA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | Ca | % | C % | C/N | Equivalent | Na | K | Ca | Mg | (meq/100 g) | % Sand | % Silt | % Clay | Texture |
| Ap | 6.6 | 6.8 | 0.88 | 7.54 | 9 | - | 0.36 | 2.04 | 31.81 | 5.02 | 37.2 | 20 | 42 | 35 | SiCL |
| Bm | 6.5 | 6.8 | 0.37 | 2.19 | 6 | - | 0.25 | 0.52 | 19.47 | 7.38 | 25.0 | 13 | 50 | 37 | SiCL |
| Cca | 7.7 | 7.6 | - | - | - | 18.39 | - | - | - | - | - | 45 | 33 | 22 | L |
| Ck | 8.0 | 7.6 | - | - | - | 19.26 | - | - | - | - | - | 40 | 37 | 23 | L |

#### Additional Analysis

| Horizon | Liquid Limit | Plastic Limit | Plasticity Index | Field $\theta$ (%) | $\theta$ Sat. (%) | % Sat at Field $\theta$ | Bulk Density Dry 105°C | K Sat Ave (cm/hr) | $\theta$ (%) at $\psi$ (ATM) 1/3 | 1 | 3 | 7 | 15 | Percolation Rate (Auger Hole) (min./inch) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | 52 | 41 | 11 | 15.8 | 66.4 | 22.8 | 0.97 | 13.0 | 38 | 28 | 27 | 25 | 26 | - |
| Bm | 38 | 25 | 13 | 10.9 | 27.9 | | 1.28 | 16.1 | 27 | 19 | 15 | 14 | 14 | - |
| Cca | 32 | 18 | 14 | 11.7 | 29.7 | 39.3 | 1.52 | 5.1 | 27 | 19 | 14 | 13 | 11 | - |

# Appendix B. (continued)

## SOIL CLIMATE DATA

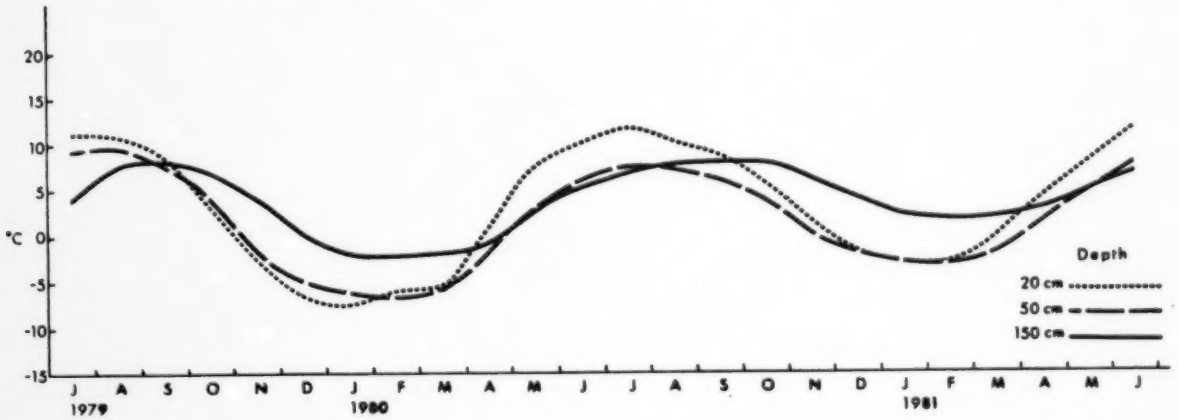
### Soil Temperature

| | | 1979 | | | | | | 1980 | | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| (°C) | 10 | 12 | 10 | 8 | 2 | -4 | -8 | -8 | -6 | -6 | 2 | 9 | 9 | 12 | 10 | 9 | 7 | 1 | -3 | -3 | -3 | 0 | 2 | 8 | 14 |
| | 20 | 11 | 11 | 9 | 3 | -3 | -7 | -8 | -6 | -6 | 1 | 8 | 10 | 12 | 10 | 9 | 6 | 1 | -2 | -3 | -3 | 0 | 4 | 8 | 12 |
| | 50 | 9 | 10 | 8 | 4 | -2 | -5 | -6 | -7 | -6 | -2 | 3 | 6 | 8 | 7 | 6 | 4 | 0 | -2 | -3 | -3 | -2 | 2 | 5 | 8 |
| | 100 | 6 | 8 | 8 | 6 | 2 | 0 | -2 | -4 | -2 | -1 | 2 | 6 | 8 | 8 | 8 | 7 | 5 | 3 | 1 | 1 | 1 | 4 | 7 | 9 |
| | 150 | 4 | 8 | 8 | 7 | 4 | 0 | -2 | -2 | -2 | -1 | 3 | 5 | 7 | 8 | 8 | 8 | 6 | 4 | 2 | 2 | 2 | 3 | 5 | 7 |

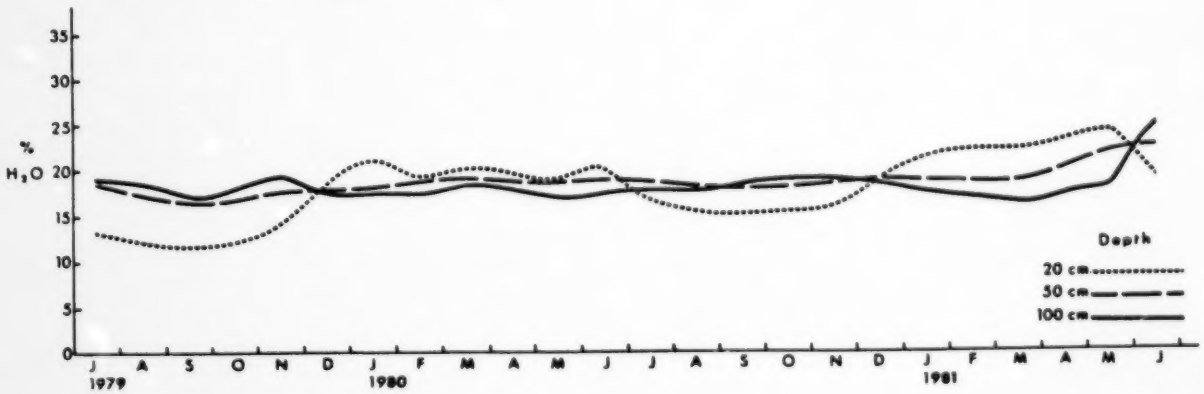
### Soil Moisture

| | | 1979 | | | | | | 1980 | | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| % $H_2O$ | 20 | 13 | 12 | 12 | 12 | 14 | 18 | 21 | 19 | 20 | 19 | 19 | 20 | 16 | 15 | 15 | 15 | 16 | 19 | 22 | 22 | 22 | 23 | 24 | 19 |
| by volume | 50 | 19 | 17 | 16 | 17 | 18 | 18 | 18 | 19 | 19 | 19 | 18 | 20 | 19 | 18 | 18 | 18 | 19 | 19 | 19 | 19 | 18 | 20 | 22 | 22 |
| | 100 | 19 | 19 | 17 | 18 | 20 | 18 | 17 | 17 | 18 | 18 | 17 | 18 | 18 | 18 | 18 | 19 | 19 | 19 | 17 | 17 | 16 | 17 | 18 | 25 |

**Soil Temperature Changes with Depth Over Time**




**Soil Moisture Changes with Depth Over Time**



# Appendix B. (continued)

## Data Pertaining to Soil Climate Monitoring Site C3

### SITE DESCRIPTION

1. Location: NE 3-25-3-W5
2. Elevation: 1181 m
3. Topography: Level to undulating, 2-5% slope
4. Drainage: Well to moderately well drained
5. Aspect: Not significant
6. Landform: Nearly level glaciolacustrine basin
7. Map unit: LLK 1
8. Soil series: Lloyd Lake
9. Parent material: Glaciolacustrine
10. Classification: Orthic Black
11. Comments: Surface horizon contains same subsoil material derived from road construction activities

### DESCRIPTION AND ANALYSES OF SOIL PROFILE

#### Profile Description

| Horizon | Depth | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ap | 30 | 10YR 2/1m | SiC | strong fine-medium granular | friable-moist | clear wavy | 0 |
| Bm | 69 | 10YR 3/2 to 3/3m | SiCL | weak medium prismatic | friable-moist | abrupt smooth | 0 |
| Cca | 107 | 2.5Y 5/2m 10YR 7/1d | SiC | amorphous | firm-moist | diffuse smooth | 0 |
| Ck | | 2.5Y 5/2m | C | amorphous | firm-moist | - | 0 |

#### Chemical Analysis

| Horizon | pH | | N | Organic | | % $CaCO_3$ | Exchangeable cations (meq/100 g) | | | | Total CEC | USDA Separates | | | USDA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | Ca | % | C % | C/N | Equivalent | Na | K | Ca | Mg | (meq/ 100 g) | % Sand | % Silt | % Clay | Texture |
| Ap | 7.5 | 7.2 | 0.51 | 6.48 | 13 | - | 0.14 | 1.13 | 36.6 | 6.15 | 72.4 | 2 | 50 | 48 | SiC |
| Bm | 7.0 | 6.7 | 0.17 | 1.90 | 11 | - | 0.06 | 0.7 | 16.47 | 8.56 | 38.6 | 2 | 53 | 45 | SiC |
| Cca | 7.9 | 7.7 | - | - | - | 25.19 | - | - | - | - | - | 0 | 60 | 40 | SiC |
| Ck | 8.0 | 7.8 | - | - | - | 15.37 | - | - | - | - | - | - | - | - | - |

#### Additional Analysis

| Horizon | Liquid Limit | Plastic Limit | Plasticity Index | Field $\theta$ (%) | $\theta$ Sat. (%) | % Sat at Field $\theta$ | Bulk Density Dry 105°C | K Sat Ave (cm/hr) | $\theta$ (%) at $\psi$ (ATM) 1/3 | 1 | 3 | 7 | 15 | Percolation Rate (Auger Hole) (min./inch) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | - | - | - | 15.8 | 41.9 | 39.2 | 1.35 | 3.83 | - | - | - | - | - | - |
| Bm | 48 | 25 | 23 | 24.1 | 39.3 | 60.7 | 1.34 | 0.473 | 65 | 24 | 21 | 18 | 10 | 8 (19)* |
| Cca | 44 | 22 | 22 | 23.2 | 35.7 | 65.4 | 1.42 | 0.779 | 26 | 19 | 16 | 14 | 12 | - |

# Appendix B. (continued)

## SOIL CLIMATE DATA

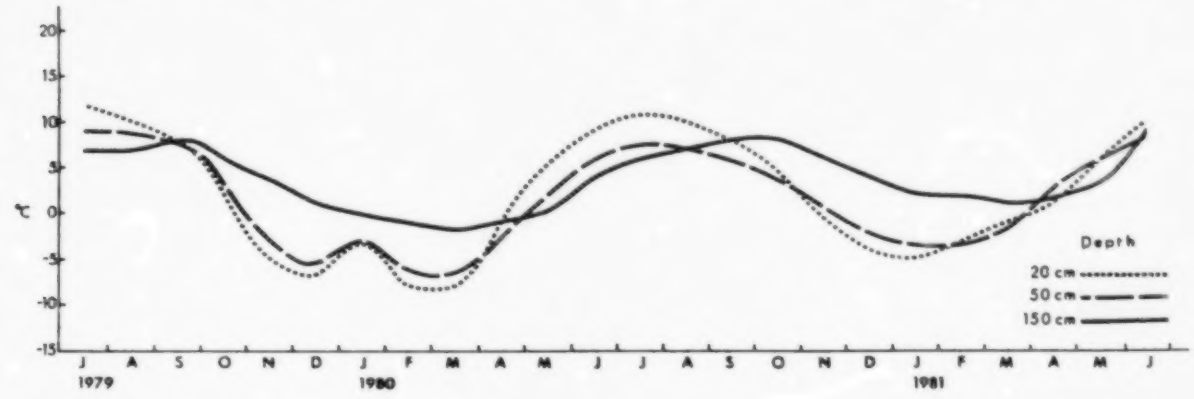
### Soil Temperature

| | | 1979 | | | | | | 1980 | | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| (°C) | 10 | 14 | 11 | 8 | 1 | -6 | -8 | -4 | -4 | -6 | -1 | 6 | 10 | 13 | 11 | 10 | 8 | 1 | -4 | -4 | -4 | -2 | 2 | 7 | 14 |
| | 20 | 12 | 10 | 8 | 2 | -5 | -7 | -3 | -8 | -8 | -1 | 5 | 9 | 11 | 10 | 8 | 5 | -1 | 4 | -5 | -3 | -1 | 1 | 6 | 10 |
| | 50 | 9 | 9 | 8 | 3 | -3 | -6 | -3 | -6 | -7 | -3 | 2 | 6 | 8 | 7 | 6 | 4 | 0 | -2 | -4 | -4 | -2 | 3 | 6 | 8 |
| | 100 | 6 | 11 | 8 | 5 | 2 | -1 | -3 | -5 | -4 | -2 | 1 | 5 | 6 | 7 | 7 | 6 | 4 | 2 | 1 | 0 | 1 | 3 | 5 | 8 |
| | 150 | 7 | 7 | 8 | 6 | 4 | 1 | 0 | -1 | -2 | -1 | 0 | 4 | 6 | 7 | 8 | 8 | 6 | 4 | 2 | 2 | 1 | 2 | 3 | 9 |

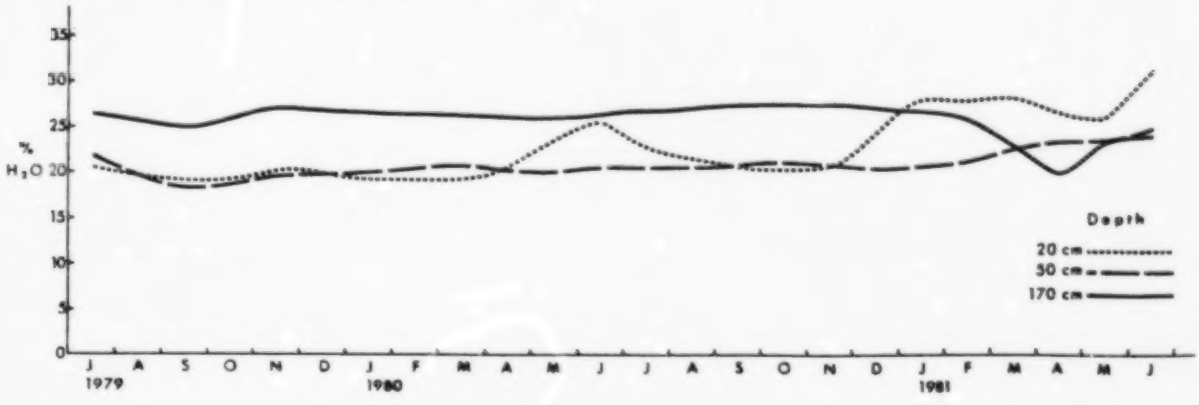
### Soil Moisture

| | | 1979 | | | | | | 1980 | | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| % $H_2O$ | 20 | 21 | 19 | 19 | 19 | 21 | 20 | 19 | 19 | 19 | 21 | 24 | 26 | 23 | 21 | 21 | 20 | 20 | 24 | 28 | 28 | 28 | 26 | 26 | 31 |
| by volume | 50 | 22 | 19 | 18 | 19 | 20 | 20 | 20 | 21 | 20 | 20 | 21 | 20 | 21 | 21 | 21 | 21 | 20 | 21 | 21 | 21 | 23 | 24 | 24 | 25 |
| | 100 | 22 | 20 | 19 | 19 | 20 | 19 | 19 | 20 | 21 | 20 | 19 | 20 | 20 | 20 | 21 | 20 | 20 | 20 | 20 | 19 | 19 | 18 | 19 | 25 |
| | 170 | 26 | 26 | 25 | 26 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 27 | 27 | 28 | 28 | 28 | 27 | 27 | 26 | 23 | 20 | 24 | 24 |

### Soil Temperature Changes with Depth Over Time




### Soil Moisture Changes with Depth Over Time



# Appendix B. (continued)

## Data Pertaining to Soil Climate Monitoring Site C4

### SITE DESCRIPTION

1. Location: NE 8-21-4-W5
2. Elevation: 1341 m
3. Topography: Inclined to undulating, 3-5% slope
4. Drainage: Moderately well drained, water table at 150 cm
5. Aspect: S but often in shade of large ridge to S about 150 m
6. Landform: Inclined to undulating glaciolacustrine
7. Map unit: FSH 5
8. Soil series: Fish Creek (western limit)
9. Parent material: Glaciolacustrine (fine clayey)
10. Classification: Orthic Black
11. Comments: Located in valley between two ridges. Free water at 150 cm, discharges into stream about 200 m south of site.

### DESCRIPTION AND ANALYSES OF SOIL PROFILE

#### Profile Description

| Horizon | Depth | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ap | 17 | 10YR 2/1m<br>10YR 3/1d | CL | moderate, coarse granular and moderate-strong, fine granular | slightly hard-dry | clear smooth | 0 |
| AB (or Ae) | 23 | 10YR 3/1m<br>10YR 4/1d | C | moderate-strong medium angular blocky & weak, medium prismatic | hard-dry | clear smooth | 0 |
| Bt | 54 | 10YR 4/1.5 | HC | strong, fine-medium subangular blocky & moderate, medium-coarse prismatic | very firm-moist | diffuse smooth | 0 |
| Cca | 75 | 10YR 4/2m<br>10YR 6/2d | HC | moderate fine subangular-blocky | very firm-moist | - | 0 |
| Ck | | 10YR 4/2d<br>10YR 6/2d | HC | amorphous | very firm-moist | - | |

#### Chemical Analysis

| Horizon | pH | | N | Organic | | % $CaCO_3$ | Exchangeable cations (meq/100 g) | | | | Total CEC | USDA Separates | | | USDA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | Ca | % | C % | C/N | Equivalent | Na | K | Ca | Mg | (meq/100 g) | % Sand | % Silt | % Clay | Texture |
| Ap | 5.7 | 6.2 | 0.81 | 6.01 | 7 | - | 0.47 | 1.0 | 26.47 | 19.98 | 49.7 | 4 | 36 | 60 | HC |
| AB | 5.7 | 6.3 | 0.26 | 2.23 | 9 | - | 0.34 | 0.83 | 25.91 | 24.33 | 46.2 | 1 | 27 | 72 | HC |
| Bt | 6.6 | 6.9 | 0.13 | 1.4 | 11 | - | 0.31 | 0.92 | 31.94 | 17.16 | 48.0 | 1 | 21 | 78 | HC |
| Cca | 7.9 | 7.7 | - | - | - | 13.03 | - | - | - | - | - | 0 | 41 | 59 | C |
| Ck | 7.9 | 7.6 | - | - | - | 12.89 | - | - | - | - | - | - | - | - | - |

#### Additional Analysis

| Horizon | Liquid Limit | Plastic Limit | Plasticity Index | Field $\theta$ (%) | $\theta$ Sat. (%) | % Sat at Field $\theta$ | Bulk Density Dry 105°C | K Sat Ave (cm/hr) | $\theta$ (%) at $\psi$ (ATM) 1/3 | 1 | 3 | 7 | 15 | Percolation Rate (Auger Hole) (min./inch) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ap | 55 | 35 | 20 | 23.5 | 57.2 | 41.3 | 1.07 | 17.4 | 35 | 31 | 28 | 25 | 27 | - |
| Bt | 71 | 28 | 43 | 25.9 | 46.0 | 54.6 | 1.30 | 15.3 | 45 | 35 | 32 | 28 | 28 | 92 (1.6)* |
| Ck | 67 | 27 | 40 | 29.7 | 37.1 | 81.4 | 1.43 | 0.116 | 40 | 32 | 28 | 24 | 24 | - |

*(cm/hr)

# Appendix B. (continued)

## SOIL CLIMATE DATA

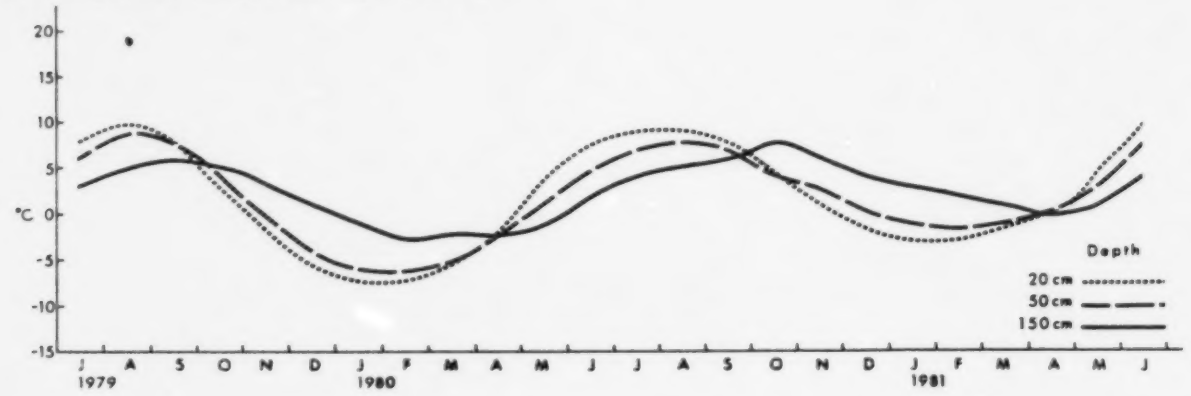
### Soil Temperature

| Temp. | Depth (cm) | 1979 J | A | S | O | N | D | 1980 J | F | M | A | M | J | J | A | S | O | N | D | 1981 J | F | M | A | M | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (°C) | 10 | 12 | 12 | 11 | 3 | -3 | -7 | -8 | -7 | -6 | 0 | 6 | 9 | 10 | 10 | 10 | 3 | 1 | -3 | -4 | -3 | 1 | 1 | 5 | 11 |
| | 20 | 8 | 10 | 8 | 3 | -2 | -6 | -8 | -7 | -6 | -2 | 4 | 8 | 9 | 9 | 8 | 4 | 1 | -2 | -3 | -3 | -1 | 0 | 5 | 10 |
| | 50 | 6 | 9 | 8 | 4 | 0 | -4 | -6 | -7 | -6 | -2 | 1 | 5 | 7 | 8 | 7 | 4 | 3 | 0 | -1 | -2 | -1 | 0 | 3 | 8 |
| | 100 | 4 | 7 | 7 | 6 | 2 | 0 | -2 | -3 | -3 | -2 | -1 | 4 | 6 | 7 | 7 | 6 | 5 | 3 | 1 | 1 | 0 | 1 | 2 | 6 |
| | 150 | 3 | 5 | 6 | 5 | 3 | 1 | -1 | -3 | -2 | -2 | -1 | 2 | 4 | 5 | 6 | 8 | 6 | 4 | 3 | 2 | 1 | 0 | 1 | 4 |

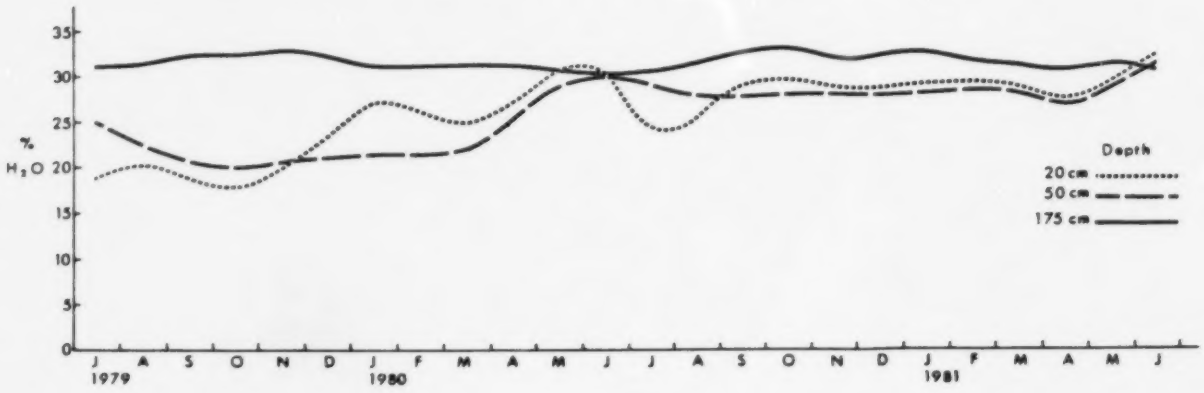
### Soil Moisture

| Moisture | Depth (cm) | 1979 J | A | S | O | N | D | 1980 J | F | M | A | M | J | J | A | S | O | N | D | 1981 J | F | M | A | M | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % $H_2O$ | 20 | 19 | 21 | 19 | 18 | 20 | 24 | 28 | 26 | 24 | 27 | 31 | 31 | 24 | 25 | 29 | 30 | 28 | 29 | 29 | 29 | 29 | 27 | 30 | 32 |
| by volume | 50 | 25 | 22 | 21 | 20 | 21 | 21 | 21 | 22 | 22 | 25 | 29 | 30 | 29 | 30 | 28 | 28 | 28 | 28 | 28 | 29 | 28 | 27 | 29 | 32 |
| | 100 | 30 | 30 | 30 | 30 | 31 | 30 | 30 | 31 | 32 | 32 | 31 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 31 | 30 | 31 | 33 |
| | 175 | 31 | 32 | 32 | 32 | 33 | 32 | 31 | 31 | 31 | 31 | 31 | 30 | 31 | 32 | 33 | 33 | 32 | 32 | 33 | 32 | 32 | 31 | 32 | 31 |

### Soil Temperature Changes with Depth Over Time




### Soil Moisture Changes with Depth Over Time



# Appendix B. (continued)

## Data Pertaining to Soil Climate Monitoring Site C5

### SITE DESCRIPTION

1. Location: SE 33-21-2-W5
2. Elevation: 1280 m
3. Topography: Undulating, 3-5% slope
4. Drainage: Well drained
5. Aspect: Very slight N aspect, some shading by trees S of site
6. Landform: Undulating till blanket over flat lying bedrock
7. Map unit: DVG 1
8. Soil series: Dunvargan
9. Parent material: Till (mixed origin, mostly wester)
10. Classification: Orthic Black
11. Comments: Slight zone of weak eluviation at base of Ah but too weak and thin to sample.

### DESCRIPTION AND ANALYSES OF SOIL PROFILE

#### Profile Description

| Horizon | Depth | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 29 | 10YR 2/1m<br>10YR 3/2d | L | moderate medium granular & weak medium-coarse prismatic | slightly hard-dry | clear wavy | 0 |
| Bm | 79 | 10YR 4/3m<br>10YR 5/3d | L-CL | moderate fine to medium subangular blocky & weak medium-coarse prismatic | hard-dry friable-moist | abrupt smooth | 1 |
| Cca | 100 | 10YR 5/2m<br>10YR 6/2d | CL | massive (& pseudo platy) | slight hard-dry | diffuse smooth | 5 |
| Ck | | 10YR 5/3m | CL | massive | slightly hard-dry | | 5-10 |

#### Chemical Analysis

| Horizon | pH | | N % | Organic C % | C/N | % $CaCO_3$ Equivalent | Exchangeable cations (meq/100 g) | | | | Total CEC (meq/100 g) | USDA Separates | | | USDA Texture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | Ca | | | | | Na | K | Ca | Mg | | % Sand | % Silt | % Clay | |
| Ah | 7.0 | 7.0 | 1.18 | 8.99 | 8 | - | 0.05 | 1.18 | 39.19 | 6.25 | 44.2 | 16 | 51 | 33 | SiCL |
| Bm | 6.4 | 6.7 | 0.2 | 1.38 | 7 | - | 0.05 | 0.55 | 15.69 | 4.61 | 22.1 | 7 | 58 | 35 | SiCL |
| Cca | 7.7 | 7.5 | - | - | - | 15.93 | - | - | - | - | - | 31 | 45 | 24 | L |
| Ck | 7.9 | 7.5 | - | - | - | 16.51 | - | - | - | - | - | - | - | - | - |

#### Additional Analysis

| Horizon | Liquid Limit | Plastic Limit | Plasticity Index | Field $\theta$ (%) | $\theta$ Sat. (%) | % Sat at Field $\theta$ | Bulk Density Dry 105°C | K Sat Ave (cm/hr) | $\theta$ (%) at $\psi$ (ATM) 1/3 | 1 | 3 | 7 | 15 | Percolation Rate (Auger Hole) (min./inch) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 48 | 32 | 16 | 16.5 | 47.6 | 34.1 | 1.09 | 2.36 | 41 | 26 | 22 | 21 | 21 | - |
| Bm | 38 | 24 | 14 | 11.8 | 34.7 | 33.2 | 1.38 | 4.76 | 28 | 19 | 17 | 15 | 15 | 25 (6.0)* |
| Cca | 27 | 17 | 10 | 8.0 | 22.7 | 37.1 | 1.55 | 2.62 | 22 | 16 | 13 | 11 | 10 | |

*(cm/hr)

# Appendix B. (continued)

## SOIL CLIMATE DATA

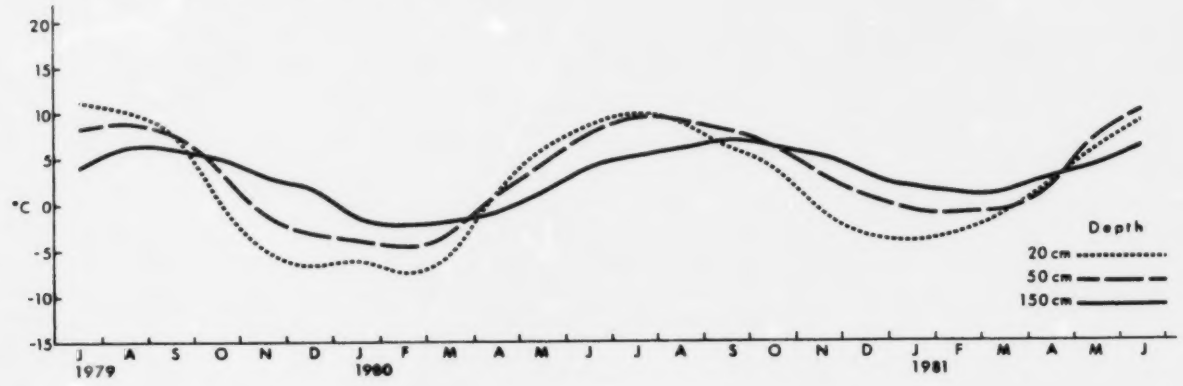
### Soil Temperature

| | | 1979 | | | | | | 1980 | | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| (°C) | 10 | 17 | 15 | 14 | 2 | -5 | -7 | -6 | -6 | -5 | 3 | 9 | 10 | 12 | 9 | 6 | 4 | -1 | -4 | -4 | -3 | 1 | 4 | 9 | 11 |
| | 20 | 11 | 10 | 8 | 1 | -5 | -7 | -6 | -8 | -6 | 1 | 6 | 8 | 10 | 9 | 6 | 4 | -1 | -4 | -4 | -3 | -1 | 2 | 6 | 9 |
| | 50 | 8 | 9 | 8 | 4 | -1 | -3 | -4 | -5 | -4 | 1 | 4 | 8 | 10 | 9 | 8 | 6 | 3 | 1 | -1 | -1 | -1 | 2 | 7 | 10 |
| | 100 | 5 | 7 | 7 | 5 | 2 | 0 | -2 | -3 | -1 | 3 | 3 | 5 | 7 | 8 | 7 | 7 | 5 | 3 | 2 | 1 | 1 | 3 | 6 | 7 |
| | 150 | 4 | 6 | 6 | 5 | 3 | 2 | -2 | -2 | -2 | -1 | 1 | 4 | 5 | 6 | 7 | 6 | 5 | 3 | 2 | 1 | 1 | 3 | 4 | 6 |

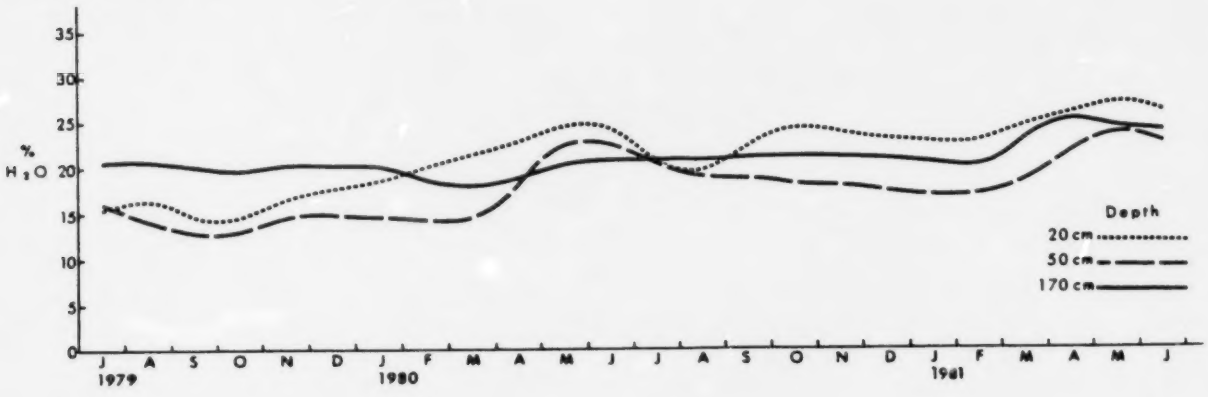
### Soil Moisture

| | | 1979 | | | | | | 1980 | | | | | | | | | | | | 1981 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture | Depth (cm) | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J |
| % $H_2O$ | 20 | 16 | 16 | 14 | 15 | 17 | 18 | 19 | 20 | 21 | 23 | 25 | 25 | 20 | 19 | 23 | 24 | 24 | 23 | 23 | 23 | 24 | 26 | 27 | 26 |
| by volume | 50 | 16 | 14 | 13 | 13 | 15 | 15 | 15 | 14 | 14 | 18 | 23 | 23 | 21 | 19 | 19 | 18 | 18 | 18 | 17 | 17 | 19 | 22 | 24 | 22 |
| | 100 | 17 | 16 | 15 | 15 | 17 | 16 | 15 | 16 | 16 | 18 | 20 | 20 | 19 | 18 | 17 | 17 | 18 | 18 | 17 | 17 | 18 | 20 | 21 | 20 |
| | 170 | 21 | 21 | 20 | 20 | 21 | 20 | 20 | 19 | 17 | 19 | 20 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 20 | 23 | 25 | 24 | 24 |

### Soil Temperature Changes with Depth Over Time




### Soil Moisture Changes with Depth Over Time



# Appendix B. (continued)

## Data Pertaining to Soil Climate Monitoring Site C6

### SITE DESCRIPTION

1. Location: NE 11-22-2-W5
2. Elevation: 1143 m
3. Topography: Inclined to gently rolling, 5-9% slope
4. Drainage: Well to moderately well, bedrock at 2.0 m may holdup W.T.
5. Aspect: Slight north aspect
6. Landform: Morainal blanket over inclined bedrock
7. Map unit: ATL 1
8. Soil series: Antler
9. Parent material: Till (mixed origin)
10. Classification: Orthic Black
11. Comments: Lower slope position about 1.5 m south of Lloyd Lake

### DESCRIPTION AND ANALYSES OF SOIL PROFILE

#### Profile Description

| Horizon | Depth | Color | Texture | Structure | Consistence | Boundary | % C.F. |
|---|---|---|---|---|---|---|---|
| Ah | 27 | 10YR 2/1m | L | moderate, fine granular | friable-moist | clear wavy | 0 |
| Bm | 51 | 10YR 3/3m | CL | moderate, medium prismatic, moderate, fine-subangular blocky | friable to firm-moist loose-dru | abrupt wavy | <1 |
| Cca | 80 | 10YR 5/3m 10YR 6/2d | CL | amorphous | friable-moist | diffuse smooth | 5 |
| Ck | | 10YR 5/3m 10YR 6/2d | CL | amorphous | friable-moist loose-dry | - | 5 |

#### Chemical Analysis

| Horizon | pH | | N % | Organic C % | C/N | % $CaCO_3$ Equivalent | Exchangeable cations (meq/100 g) | | | | Total CEC (meq/ 100 g) | USDA Separates | | | USDA Texture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | Ca | | | | | Na | K | Ca | Mg | | % Sand | % Silt | % Clay | |
| Ah | 6.4 | 6.4 | 0.59 | 6.8 | 12 | - | 0.10 | 1.18 | 28.28 | 6.0 | 63.0 | 10 | 50 | 40 | SiC |
| Bm | 6.4 | 5.7 | 0.17 | 2.0 | 12 | - | 0.07 | 0.70 | 17.13 | 4.1 | 42.1 | 6 | 45 | 49 | SiC |
| Cca | 7.6 | 7.4 | - | - | - | 22.2 | - | - | - | - | - | 16 | 47 | 37 | SiCL |
| Ck | 7.8 | 7.6 | - | - | - | 19.7 | - | - | - | - | - | - | - | - | - |

#### Additional Analysis

| Horizon | Liquid Limit | Plastic Limit | Plasticity Index | Field $\theta$ (%) | $\theta$ Sat. (%) | % Sat at Field $\theta$ | Bulk Density Dry 105°C | K Sat Ave (cm/hr) | $\theta$ (%) at $\psi$ (ATM) 1/3 | 1 | 3 | 7 | 15 | Percolation Rate (Auger Hole) (min./inch) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ah | 68 | 48 | 20 | 18.4 | 85.1 | 21.6 | 0.82 | 15.7 | 40 | 32 | 30 | 30 | 30 | - |
| Bm | 47 | 26 | 21 | 13.1 | 39.2 | 34.5 | 1.34 | 11.1 | 26 | 22 | 20 | 18 | 18 | 9 (16.9)* |
| Cca | 43 | 25 | 18 | 10.6 | 32.6 | 34.5 | 1.45 | 1.7 | 30 | 23 | 20 | 16 | 15 | - |

*(cm/hr)

## Appendix B. (continued)

### SOIL CLIMATE DATA

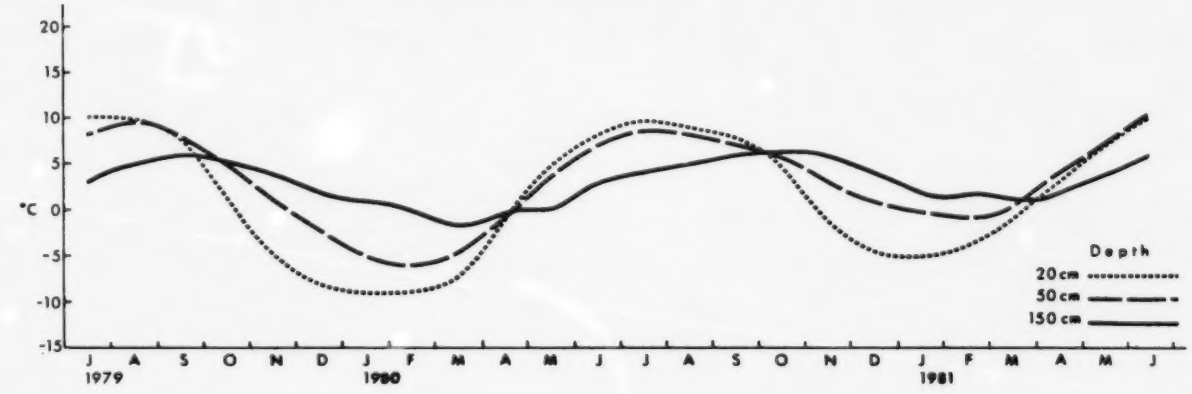
**Soil Temperature**

| Temp. | Depth (cm) | 1979 J | A | S | O | N | D | 1980 J | F | M | A | M | J | J | A | S | O | N | D | 1981 J | F | M | A | M | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (°C) | 10 | 13 | 18 | 14 | 2 | -5 | -8 | -8 | -8 | -7 | 1 | 8 | 10 | 13 | 10 | 8 | 6 | -1 | -5 | -2 | 0 | 1 | 4 | 8 | 11 |
| | 20 | 10 | 10 | 8 | 2 | -5 | -8 | -9 | -9 | -8 | -1 | 5 | 8 | 10 | 9 | 8 | 5 | -1 | -5 | -5 | -4 | -1 | 3 | 7 | 10 |
| | 50 | 8 | 10 | 8 | 5 | 1 | -2 | -5 | -6 | -5 | -1 | 4 | 7 | 9 | 8 | 7 | 6 | 3 | 1 | 0 | -1 | 0 | 4 | 7 | 10 |
| | 100 | 4 | 7 | 7 | 5 | 3 | 0 | -2 | -3 | -2 | 0 | 2 | 5 | 6 | 7 | 7 | 7 | 5 | 3 | -1 | -2 | 1 | 3 | 5 | 7 |
| | 10 | 3 | 5 | 6 | 5 | 4 | 2 | 1 | 0 | -2 | 0 | 0 | 3 | 4 | 5 | 6 | 6 | 6 | 4 | 2 | 2 | 1 | 2 | 4 | 6 |

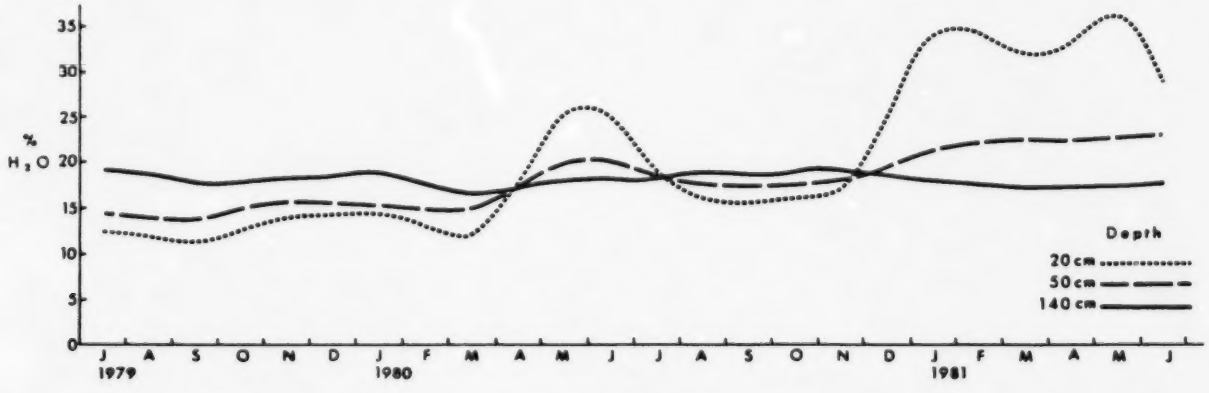
**Soil Moisture**

| Moisture | Depth (cm) | 1979 J | A | S | O | N | D | 1980 J | F | M | A | M | J | J | A | S | O | N | D | 1981 J | F | M | A | M | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % $H_2O$ | 20 | 12 | 12 | 11 | 13 | 14 | 14 | 14 | 13 | 11 | 18 | 26 | 25 | 18 | 16 | 16 | 16 | 16 | 25 | 34 | 34 | 32 | 33 | 36 | 29 |
| by volume | 50 | 15 | 14 | 14 | 15 | 15 | 15 | 15 | 15 | 14 | 17 | 20 | 20 | 19 | 18 | 17 | 18 | 18 | 20 | 22 | 22 | 23 | 22 | 23 | 23 |
| | 100 | 17 | 16 | 14 | 15 | 16 | 15 | 16 | 15 | 14 | 16 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 19 | 20 |
| | 140 | 19 | 19 | 18 | 18 | 18 | 18 | 19 | 18 | 16 | 17 | 18 | 18 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 17 | 17 | 17 | 18 |

**Soil Temperature Changes with Depth Over Time**




**Soil Moisture Changes with Depth Over Time**



# Appendix C. Evaluation of soil variability of selected soil units and soil series

Until recently, most descriptions of soil survey map units were based on estimates made by the surveyor and tested only in a general, qualitative manner. These estimates are useful first approximations, but a better understanding of the reliability of the estimates is needed where maps are to be used in a quantitative manner. This has lead to an increased demand for unbiased evaluation of the composition of soil map units and for improved characterization of the soil property values within map units.

Such an evaluation was carried out for fourteen of the more extensive soil units mapped in the Calgary survey area. In total, these units cover about 50 percent of the entire map area.

The random transect method (Steers and Hajek, 1979, Arnold, 1977 and 1979) was used to extract an unbiased set of samples from among the total available population of soil unit delineations. The resulting sample set was used to evaluate series and soil property composition for each sampled soil unit. Ninety percent confidence intervals for prediction of true mean values were generated for major series composition within units and for means of important soil properties like pH or percent clay within each unit. The results of this sampling and evaluation are presented in the accompanying tables. A brief description of the significance of each evaluation and the manner in which it was conducted precedes each table.

**Soil unit series composition**

Soil units are conceptual descriptions of repeating landscape patterns in which names of individual kinds of soils (soil series) are used to describe and predict the classes of soil with the soil unit and the likely soil properties associated with those classes. In general, one or two soil series names are considered to describe the majority of soil types found within a given outlined area, although it is recognized that many other soil types may be included in lesser proportions.

This concept of map unit composition can be illustrated with reference to a hypothetical soil unit ABC 2 which is described as being composed of 60 percent soil series X and 40 percent soil series Y. The numbers 60 percent soil X and 40 percent soil Y are generally just estimates designed to confer the information that soil X covers the largest proportion of the outlined area and that soil Y covers a substantial, but smaller, proportion. There is no confidence level attached to these estimates and no way of knowing how closely they approximate the truth.

The sampling program conducted for this survey area permited us to make somewhat more-accurate estimates of the series composition of the tested map units and to attach a specific level of confidence to the estimates. The estimates given in table 1 were computed for a 90 percent confidence level. This means roughly that if we were to resample the soil unit repeatedly in the same manner and using the same number of observation sites, we would calculate a mean value for the estimated series composition that fell within our initial computed estimates nine times out of ten. In other words, there is one chance in ten that the true mean value for the estimated series composition made for any map unit is outside the range which we have calculated.

The proportions given in table 1 are for established soil series, which are described elsewhere in this report, or occasionally for groupings of soil series which display similar properties or interpretations. The various groupings used are explained following the table. The utility of table 1 lies in its ability to give accurate estimates of the proportions of major soil series present in the tested map units.

**Soil property values by soil unit**

The unbiased sampling scheme permitted quantitative estimates to be made of a number of measureable field determined morphological properties and laboratory determined physical and chemical properties for each soil unit or soil series that was sampled. The following tables present the ninety percent (90%) confidence intervals for estimates of the mean for these morphologic, physical and chemical properties. They are presented first for all samples collected within a given soil unit (table 2) and then repeated for all samples recognized as belonging to an individual soil series (i.e., ADY) (table 3).

The tables can be used to determine, at 90 percent level of confidence, the likely range or interval within which the true mean value for selected soil properties for a given soil unit or soil series lies. Some caution should be exercised in using these tables in order to avoid inappropriate use. For instance, an average value of 40 percent for sand for an area X consisting of 50 percent sandy soils with 70 percent sand and 50 percent clayey soils with 10 percent sand does not give a realistic notion of the kind of soil texture to expect in that area. It is better to know the average sand content of the two main soil types and to know that they occur in roughly equal amounts. This example does not occur in this data set, it is given simply for illustrative purposes.

In general, soil units show greater variation for any given property than exhibited by the soil series that is used to name the unit. This reflects the fact that all soils sampled within a given unit are used to compute average values for that unit whereas only those soils that match the more narrow descriptions established for soil series are included in the calculation of soil series means. Most users will want information about soil unit characteristics since management decisions most often apply to these areal units. In some cases, the user will be familiar with individual soil series and will be able to recognize these series at specific sites. In these cases, the soil series average properties will be of greater interest.

It should be noted that the confidence limits indicate

## Appendix C. (continued)

a 90 percent probability that the mean value of a property for a soil series or soil unit falls within the indicated range. Individual sampled sites will often display property values outside this range. Studies in soil variability are increasingly showing, however, that a large portion of the variability in the properties of any soil series or soil unit occurs within relatively short distances (1-5 meters) (Nortcliff 1978, McBratney, 1985). Given this fact, it is probably better to have knowledge of the mean value of a soil property for a given class of soil and to use this mean value to describe volumes or areas of soil than it is to rely on a single soil property measurement at a site. The reported ranges, therefore, may not accurately predict actual values at all given sites with a soil class, but they are likely to be more representative of average conditions over an area or volume described as that class (soil series/soil unit) than any single measurement could be.

Tables 2 and 3 list 90 percent confidence for the mean values of selected morphological, physical and chemical properties for the tested soil units and soil series respectively. Knowledge of morphologic measurements such as Ah thickness or depth to lime is useful for evaluating soil characteristics such as rooting depth and topsoil depth. The B horizon thickness is a useful measure of profile development strength while the depth to second parent material is useful to know if the parent materials are strongly contrasting. The average percent slope gives useful information about the typical surface form of soil units or series.

Knowledge of physical properties such as texture and plasticity characteristics is very useful for planning construction or engineering activities. These data are also useful in predicting moisture holding and transmission characteristics of the soils. The values reported in the tables are for samples taken from the lowest horizons generally at depths of 60-100 cm. Soils formed on similar parent materials (i.e., clay loam till) do not generally show major differences with respect to these properties but soils formed on different parent materials (i.e., till, glaciolacustrine, glaciofluvial) can display significant differences. These data should prove very useful for determining mean soil parent material physical properties.

The major chemical properties reported for the various soil units and soil series are surface and subsurface pH, organic carbon of the surface horizon and calcium carbonate percent of the C horizon. The surface horizon pH and organic carbon values are useful indicators of potential fertility and degree of leaching or organic matter removal. The percent calcium carbonate and pH of the C horizons give some indication of the amount of carbonate buildup or deep leaching and of the innate parent material carbonate content.

### Soil variability as measured by CV

Coefficient of variability (CV) is a simple and straightforward measure of relative soil variability. CV is defined as the ratio of the standard deviation of a series of soil property measurements to the mean soil property value according to the formula:

$$CV = SD(x)/\bar{x} * 100$$

Coefficients of variation give a good first impression of the relative variability of any given soil property or soil class. High CV values indicate high relative variability, whereas low values indicate low variability. CV's are given for all of the soil properties reported previously for all of the tested soil units and soil series (tables 4 to 5). Examination of the tables can reveal which soil properties are generally highly variable and which are less variable. It can also be determined if a given soil unit or soil series is more highly variable than others with respect to a given property or series of properties.

The coefficient of variation data presented in tables 4 and 5 have been summarized (table 6). The CVs are ranked from lowest (least variable) to highest (most variable) and are compared to CVs determined in other areas by other studies. The values obtained for the Calgary area are roughly similar to those obtained elsewhere, as are the relative rankings. This table shows which soil properties have generally low variability and which are generally high. More confidence should be placed on interpretations based on properties with low variability than on those with high variability.

**Table 1.** Soil unit series composition

| Soil Unit | Series or Soil Class | Mean 90% Confidence Interval Value | Lower | Upper |
|---|---|---|---|---|
| RKAD 1 | RKV | 48 | 36 | 60 |
| ATL 1 | ATL | 87 | 79 | 96 |
| DEL 1 | DEL | 74 | 62 | 85 |
| | RKV | 16 | 7 | 25 |
| DVG 1 | DVG | 45 | 30 | 60 |
| ELRS 1 | ELB and similar soils | 33 | 23 | 43 |
| | RSN and similar soils | 8 | 2 | 15 |
| | Orthic Gray Luvisols on clayey LG or till | 23 | 15 | 35 |
| | SPR | 13 | 6 | 22 |
| | POT | 17 | 9 | 26 |
| FSH 1 | FSH | 75 | 65 | 86 |
| FSH 2 | FSH | 37 | 24 | 50 |
| | POT | 25 | 15 | 35 |
| FSH 3 | FSH | 47 | 30 | 65 |
| | LCON (LG/Till) | 45 | 28 | 62 |

# Appendix C. (continued)

**Table 1.** Soil unit series composition

| Soil Unit | Series or Soil Class | Mean 90% Confidence Interval Value | Lower | Upper |
|---|---|---|---|---|
| LLK 1 | LLK | 42 | 30 | 54 |
| | BPW | 29 | 18 | 40 |
| | LCON (CABL) | 18 | 8 | 28 |
| LTC 1 | LTC | 27 | 15 | 40 |
| | LCON (OGL) | 20 | 10 | 30 |
| | HCON | 26 | 14 | 38 |
| SPR 1 | SPR | 52 | 39 | 65 |
| | HCON | 22 | 12 | 32 |
| SPY 1 | SPY | 61 | 48 | 75 |
| | HCON (gleyed soils) | 20 | 10 | 30 |
| SRC 1 | SRC | 40 | 25 | 55 |
| | LCON | 25 | 10 | 40 |
| | MCON | 30 | 15 | 46 |
| SRC 2 | SRC | 12 | 5 - 20 | |
| | LCON | 35 | 23 - 48 | |
| | MCON | 26 | 14 - 38 | |
| | HCON | 35 | 23 - 48 | |

* Descriptions of non series classes used in table 1.

for ELRS 1 - This unit was redefined as a result of the transects undertaken for the study. Soils were grouped according to similar characteristics as detailed below.
ELB and similar soils - includes several soils classified as Orthic Dark Grays which are very similar to the Dark Gray Luvisol classification applied to ELB. The soils are otherwise almost identical.
RSN and similar soils - includes similar Orthic Dark Gray Chernozemic soils on fine clayey till. These are almost the same as RSN which is a Dark Gray Luvisol on the same fine clayey till.
Orthic Gray Luvisols - includes soils formed on fine clayey till and glaciolacustrine parent materials. These soils differ from ELB and RSN only in that they have less than 5 cm of dark gray topsoil (Ahe).
SPR and similar soils - includes all Orthic Gray Luvisols on stony fine loamy till.

for FSH 3 - LCON groups all of those soils that are very similar to Fish Creek (FSH) but that were described as having a change in parent material from clayey glaciolacustrine to clayey till within the 100 cm profile depth. FSH 3 unit was meant to separate those areas with shallow depths to till from those with deep glaciolacustrine deposits (FSH 1). This sampling confirms that the desired separation was achieved.

for LLK 1 - LCON groups a number of observations that did not meet the criterion for taxonomic classification as Orthic Blacks (LLK) or Rego Blacks (BPW). These soils were classified as calcareous blacks but were in all other ways (i.e., drainage, parent material) similar to BPW and LLK.

for LTC 1 - LCON groups a number of soils that were classified as Orthic Grey Luvisols rather than Dark Gray Luvisols (LTC). The distinction is relatively minor as in most cases the Orthic Gray Luvisols had just under 5 cm of Ahe horizon and the Dark Gray Luvisols had just over 5 cm of Ahe. Taxonomically this resulted in two different subgroup classifications. In fact, these two separations are more correctly viewed as a single soil type with a thin Ahe horizon that ranges in thickness from 3 to 8 cm.
HCON groups a number of soils which are quite different from LTC series. These soils are mostly Rego Chernozems with thick accumulations of cumulic black topsoil. They occur in draws and toeslopes where slopewash accumulates. They were included in the conceptual description of the unit and are described separately since they differ substantially from the description for Leighton Centre.

for SPR 1 - HCON groups a number of soils that contrast highly with the description of Spruce Ridge series (SPR). These high contrast soils differ mainly in having either a lithic contact within 100 cm of the surface or in having a deep surface accumulation of black topsoil (slopewash). Both of these different kinds of soil were recognized in the original map unit description so the sampling program confirmed their presence and relative extent.

for SPY 1 - HCON groups all Gleyed soils and Gleysols. Originally, SPY 1 soil unit was defined as containing only a limited proportion of poorly or imperfectly drained soils. The sampling program confirmed this assumption and established limits for proportions of included poorly drained soils.

for SRC 1 - LCON groups alluvial soils that are very similar to Sarcee (SRC). These soils differed from Sarcee mainly in regard to their profile development and taxonomic composition. Sarcee was classified as an Orthic Black Chernozemic soil. Most of these similar soils were developed the same alluvial parent material as Sarcee and were similarly well drained but were classified as Rego Black Chernozemics or Humic Regosols.
MCON groups those soils that were slightly gleyed or exhibited a layer of gravelly parent material within the 100 cm profile examination depth.

for SRC 2 - LCON groups alluvial soils similar to Sarcee as described above for SRC 1. It is interesting to note that these 'Cumulic' or 'Rego' soils occur in greater abundance than the original naming soil (SRC) in this soil unit. This is actually very supportive of the quality of the mapping as SRC 2 unit was intended to describe a more variable landscape than SRC 1 unit and one containing more Rego and Cumulic soils.
MCON groups those Alluvial soils with gleying or gravel within 100 cm of the surface as described above for SRC 1.
HCON groups those soils that are poorly drained (Gleysols) or mostly gravel and contrast strongly with the description of Sarcee series. The high proportion of high contrast soils is expected since this unit is mapped in dissected, highly variable, active stream channels.

## Appendix C. (continued)

**Table 2.** Confidence intervals for soil properties by soil unit

| Soil units | ATL 1 | DEL 1 | DVG 1 | ELRS 1 | FSH 1 | FSH 2 | FSH 3 |
|---|---|---|---|---|---|---|---|
| **Properties** | | | | | | | |
| Ah (Ahe) thickness (cm) | 17-21 | 16-19 | 18-22 | 12-23 | 21-24 | 18-22 | 18-23 |
| B Horizon thickness (cm) | 26-33 | 28-33 | 32-44 | 42-50 | 28-33 | 19-48 | 27-34 |
| Lime depth (cm) | 43-51 | 42-50 | 54-66 | 60-68 | 49-55 | 32-48 | 46-58 |
| Second PM depth (cm) | - | 68-84 | 54-75 | 62-78 | - | - | 70-93 |
| Coarse fragments (%) | 9-11 | 3-4 | 3-5 | 3-7 | 0-3 | - | - |
| % slope | 4-5 | 2-3 | 6-8 | 7-10 | 4-5 | 3-4 | 3-4 |
| Plastic limit | 22-23 | 18-20 | 22-24 | 22-24 | 24-26 | 22-25 | 24-26 |
| Liquid limit | 35-38 | 32-35 | 39-44 | 43-48 | 49-53 | 42-46 | 45-51 |
| Plasticity index | 13-15 | 14-15 | 17-21 | 21-25 | 24-27 | 19-22 | 20-25 |
| % sand | 15-18 | 28-33 | 8-12 | 4-13 | 5-7 | 5-7 | 5-8 |
| % silt | 50-52 | 39-43 | 42-48 | 40-47 | 34-39 | 42-47 | 35-44 |
| % clay | 30-34 | 27-30 | 41-49 | 44-52 | 54-60 | 47-53 | 50-59 |
| A Horizon pH | 6.2-6.5 | 5.4-5.7 | 5.6-5.9 | 5.4-5.7 | 5.8-6.1 | 6.4-6.7 | 5.8-6.3 |
| C Horizon pH | 7.5-7.6 | 7.7-7.8 | 7.4-7.6 | 7.2-7.4 | 7.6-7.7 | 7.7-7.9 | 7.6-7.8 |
| Organic carbon (%) | 5.5-6.3 | 4.2-4.8 | 6.4-7.1 | 4.2-6.7 | 6.8-7.8 | 8.0-10.3 | 7.1-9.3 |
| C Horizon carbonate (%) | 17-20 | 13-16 | 14-17 | 9-20 | 15-19 | 24-31 | 12-18 |

**Table 2.** continued

| Soil units | LLK 1 | LTC 1 | RKAD 1 | SPR 1 | SPY 1 | SRC 1 | SRC 2 |
|---|---|---|---|---|---|---|---|
| **Properties** | | | | | | | |
| Ah (Ahe) thickness (cm) | 19-24 | 13-23 | 16-23 | 1-14 | 13-19 | 24-32 | 18-25 |
| B Horizon thickness (cm) | 18-25 | 47-58 | 20-26 | 36-51 | 22-30 | 39-63 | 30-54 |
| Lime depth (cm) | 35-50 | 68-81 | 37-49 | 52-66 | 36-47 | 36-47 | 33-57 |
| Second PM depth (cm) | - | - | 63-74 | 51-89 | - | 62-77 | 73-113 |
| Coarse fragments (%) | 0-3 | 9-11 | 2-4 | 16-26 | 16-27 | - | 10-50 |
| % slope | 4-6 | 13-19 | 3-4 | 23-31 | 7-13 | 1-2 | 1-2 |
| Plastic limit | 22-24 | 18-21 | 20-21 | 19-22 | 22-26 | 21-24 | 21-24 |
| Liquid limit | 35-38 | 30-34 | 32-34 | 31-39 | 37-40 | 30-36 | 34-38 |
| Plasticity index | 13-15 | 12-14 | 12-13 | 13-18 | 13-16 | 9-12 | 11-15 |
| % sand | 9-12 | 22-28 | 20-24 | 23-31 | 19-27 | 25-38 | 28-36 |
| % silt | 56-60 | 47-52 | 49-52 | 40-46 | 45-50 | 44-53 | 43-48 |
| % clay | 29-34 | 24-28 | 26-29 | 26-35 | 27-32 | 18-24 | 20-16 |
| A Horizon pH | 7.1-7.2 | 5.2-5.6 | 7.1-7.2 | 4.9-5.2 | 5.8-6.3 | 5.9-6.5 | 6.5-7.0 |
| C Horizon pH | 7.8-7.9 | 7.4-7.5 | 7.8-7.9 | 5.9-6.4 | 7.4-7.6 | 7.0-7.4 | 7.4-7.5 |
| Organic carbon (%) | 5.7-6.2 | 4.6-6.5 | 4.0-4.6 | 1.7-2.5 | 7.7-9.8 | 6.1-8.4 | 6.2-10.1 |
| C Horizon carbonate (%) | 25-29 | 10-15 | 23-25 | 1-2 | 13-19 | 5-9 | 8-12 |

**Table 3.** Confidence intervals for soil properties by soil series

| Soil series | ADY | ATL | BPW | DEL | DVG | EBO | ELB | FSH |
|---|---|---|---|---|---|---|---|---|
| **Properties** | | | | | | | | |
| Ah (Ahe) thickness (cm) | 13-19 | 17-21 | 14-19 | 16-18 | 20-26 | 13-17 | (9-11) | 22-25 |
| B Horizon thickness (cm) | 17-25 | 26-33 | - | 28-34 | 33-43 | - | 30-44 | 26-31 |
| Lime depth (cm) | 31-43 | 44-53 | - | 44-51 | 57-70 | 13-20 | 50-70 | 50-55 |
| Second PM depth (cm) | - | - | - | - | - | 56-84 | - | - |
| Coarse fragments (%) | 4-7 | 9-11 | 0 | 3-4 | 4-9 | 1-2 | 0-5 | - |
| % slope | 3-4 | 4-6 | 5-9 | 2-3 | 6-11 | 2-3 | 5-13 | 4-5 |
| Plastic limit | 18-21 | 22-23 | 22-25 | 19-20 | 20-23 | 19-23 | 23-27 | 25-26 |
| Liquid limit | 30-34 | 35-37 | 33-39 | 35-36 | 35-41 | 34-40 | 49-59 | 49-52 |
| Plasticity index | 11-14 | 13-14 | 11-14 | 15-17 | 15-18 | 14-17 | 25-32 | 24-27 |
| % sand | 25-32 | 15-19 | 8-15 | 30-32 | 10-17 | 6-26 | 4-5 | 5-6 |
| % silt | 44-49 | 51-53 | 54-59 | 37-39 | 46-52 | 43-58 | 30-41 | 34-40 |
| % clay | 23-27 | 30-33 | 28-37 | 30-32 | 33-42 | 30-36 | 55-65 | 56-61 |
| A Horizon pH | 6.5-7.1 | 6.1-6.4 | 7.1-7.3 | 5.3-5.6 | 5.5-5.9 | 6.0-6.1 | 5.3-5.7 | 5.9-6.2 |
| C Horizon pH | 7.7-7.9 | 7.5-7.6 | 7.8-8.0 | 7.7-7.8 | 7.5-7.6 | 7.6-8.1 | 7.3-7.6 | 7.6-7.7 |
| Organic carbon (%) | 3.7-5.1 | 5.6-6.4 | 5.2-6.0 | 4.3-5.0 | 6.5-7.4 | 4.5-5.2 | 4.8-7.1 | 7.2-8.1 |
| C Horizon carbonate (%) | 18-23 | 17-20 | 24-32 | 12-13 | 14-17 | 16-40 | 9-20 | 16-20 |

## Appendix C. (continued)

**Table 3.** (continued)

| Soil series | LLK | LTC | POT | RKV | SPR | SPY | SRC |
|---|---|---|---|---|---|---|---|
| **Properties** | | | | | | | |
| Ah (Ahe) thickness (cm) | 20-26 | (2-3) | 15-21 | 17-20 | (2-4) | 13-15 | 23-32 |
| B Horizon thickness (cm) | 19-26 | 50-67 | 33-51 | 23-29 | 43-62 | 22-31 | 39-70 |
| Lime depth (cm) | 41-52 | 62-83 | 45-72 | 41-49 | 57-69 | 35-45 | 56-105 |
| Second PM depth (cm) | - | - | - | 66-75 | - | - | - |
| Coarse fragments (%) | 0-3 | 7-10 | - | 1-2 | 17-23 | 16-31 | - |
| % slope | 3-4 | 6-17 | 2-5 | 2-3 | 19-28 | 7-12 | 1-2 |
| Plastic limit | 21-24 | 17-25 | 21-27 | 20-21 | 19-21 | 22-26 | 19-21 |
| Liquid limit | 21-24 | 17-25 | 21-27 | 20-21 | 19-21 | 22-26 | 19-21 |
| Plasticity index | 12-16 | 11-15 | 19-31 | 12-14 | 13-16 | 14-17 | 8-10 |
| % sand | 7-13 | 15-26 | 4-15 | 18-22 | 28-34 | 17-23 | 17-30 |
| % silt | 54-61 | 48-56 | 34-47 | 50-54 | 39-43 | 46-51 | 51-62 |
| % clay | 27-37 | 24-32 | 41-59 | 26-30 | 26-30 | 30-34 | 18-22 |
| A Horizon pH | 7.0-7.2 | 4.5-5.1 | 6.1-6.7 | 6.2-6.8 | 4.8-5.1 | 5.8-6.3 | 5.4-6.1 |
| C Horizon pH | 7.7-7.8 | 7.4-7.5 | 7.2-7.7 | 7.7-7.9 | 5.9-6.5 | 7.4-7.6 | 6.8-7.4 |
| Organic carbon (%) | 5.4-6.0 | 1.5-3.6 | 6.7-12.4 | 4.0-4.5 | 1.1-1.7 | 7.7-9.8 | 5.3-6.3 |
| C Horizon carbonate (%) | 23-29 | 7-15 | 11-22 | 21-25 | 1-3 | 13-19 | 2-5 |

**Table 4.** Coefficients of variability for soil properties by soil unit

| Soil units | ATL 1 | DEL 1 | DVG 1 | ELRS 1 | FSH 1 | FSH 2 | FSH 3 | LLK 1 |
|---|---|---|---|---|---|---|---|---|
| **Soil properties** | | | | | | | | |
| Ah (Ahe) thickness (cm) | 38 | 35 | 28 | 20 | 31 | 34 | 36 | 44 |
| B thickness (cm) | 38 | 33 | 45 | 32 | 36 | 58 | 31 | 51 |
| Lime depth (cm) | 35 | 35 | 32 | 25 | 27 | 64 | 27 | 52 |
| Second PM depth (cm) | - | 19 | 23 | 24 | 17 | 22 | 26 | - |
| Coarse fragments (%) | 46 | 58 | 55 | 120 | 43 | 114 | 127 | 59 |
| % slope | 50 | 50 | 45 | 73 | 67 | 51 | 36 | 67 |
| Plastic limit | 12 | 18 | 15 | 14 | 12 | 16 | 12 | 11 |
| Liquid limit | 13 | 18 | 19 | 17 | 16 | 15 | 15 | 17 |
| Plasticity index | 22 | 17 | 28 | 24 | 24 | 23 | 25 | 33 |
| % sand | 36 | 33 | 61 | 81 | 49 | 67 | 55 | 66 |
| % silt | 8 | 20 | 19 | 31 | 28 | 20 | 29 | 11 |
| % clay | 21 | 17 | 13 | 32 | 29 | 29 | 23 | 27 |
| A Horizon pH | 8 | 8 | 7 | 22 | 11 | 10 | 11 | 3 |
| C Horizon pH | 2 | 2 | 4 | 8 | 3 | 3 | 3 | 2 |
| Organic carbon (%) | 22 | 24 | 18 | 36 | 29 | 42 | 12 | 14 |
| C Horizon carbonate (%) | 28 | 43 | 34 | 72 | 52 | 40 | 43 | 27 |
| Ahe (Ae) thickness (cm) | - | 33 | 85 | 32 | 80 | 30 | 38 | - |
| LFH thickness (cm) | - | - | - | 72 | - | 68 | - | - |
| Average CV for unit | 25 | 25 | 26 | 35 | 27 | 33 | 30 | 32 |

## Appendix C. (continued)

**Table 4.** (continued)

| Soil units | LTC 1 | RKAD 1 | SPR 1 | SPY 1 | SRC 1 | SRC 2 | Average |
|---|---|---|---|---|---|---|---|
| **Soil properties** | | | | | | | |
| Ah (Ahe) thickness (cm) | 76 | 75 | - | 62 | 40 | 49 | 44 |
| B thickness (cm) | 37 | 48 | 57 | 46 | 55 | 60 | 45 |
| Lime depth (cm) | 28 | 50 | 34 | 41 | 42 | 64 | 40 |
| Second PM depth (cm) | 19 | 25 | 33 | 32 | 16 | 20 | 24 |
| Coarse fragments (%) | 35 | 84 | 80 | 80 | 50 | 101 | 75 |
| % slope | 57 | 41 | 53 | 84 | 45 | 40 | 54 |
| Plastic limit | 25 | 13 | 24 | 23 | 19 | 19 | 17 |
| Liquid limit | 22 | 13 | 24 | 23 | 19 | 19 | 17 |
| Plasticity index | 25 | 13 | 24 | 23 | 19 | 19 | 17 |
| % sand | 46 | 37 | 49 | 52 | 57 | 36 | 52 |
| % silt | 16 | 11 | 22 | 15 | 27 | 18 | 20 |
| % clay | 25 | 22 | 47 | 27 | 40 | 40 | 27 |
| A Horizon pH | 12 | 3 | 9 | 10 | 13 | 10 | 10 |
| C Horizon pH | 3 | 3 | 13 | 3 | 7 | 2 | 4 |
| Organic carbon (%) | 60 | 26 | 67 | 30 | 43 | 77 | 36 |
| C Horizon carbonate (%) | 62 | 23 | 192 | 43 | 82 | 61 | 57 |
| Ahe (Ae) thickness (cm) | 50 | - | 158 | - | 57 | 25 | 59 |
| LFH thickness (cm) | 55 | - | 49 | - | - | - | 61 |
| Average CV for unit | 30 | 31 | 43 | 37 | 35 | 39 | 37 |

**Table 5.** Coefficients of variability for soil properties by soil series

| Soil units | ADY | ATL | BPW | DEL | DVG | EBO | ELB | FSJ | LLK | LTC | POT | RKV | SPR | SPY | SRC | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Soil properties** | | | | | | | | | | | | | | | | |
| Ah (Ahe) thickness (cm) | 38 | 38 | 32 | 22 | 35 | 11 | 19 | 32 | 31 | - | 39 | 27 | - | 27 | 31 | 29 |
| B thickness (cm) | 44 | 38 | 37 | 35 | 36 | - | 35 | 42 | 38 | 20 | 46 | 37 | 49 | 42 | 55 | 40 |
| Lime depth (cm) | 36 | 32 | 31 | 26 | 26 | 4 | 30 | 26 | 30 | 19 | 55 | 28 | 21 | 32 | 53 | 30 |
| Second PM depth (cm) | - | - | - | - | - | 17 | - | - | - | - | 16 | 22 | - | - | - | 18 |
| Coarse fragments (%) | 62 | 42 | - | 47 | 94 | 47 | - | 70 | 69 | 28 | 100 | 56 | 42 | 82 | 47 | 60 |
| % slope | 39 | 57 | 64 | 44 | 67 | 23 | 83 | 63 | 48 | 68 | 79 | 26 | 52 | 64 | 42 | 55 |
| Plastic limit | 14 | 12 | 14 | 9 | 17 | 8 | 14 | 11 | 8 | 25 | 21 | 10 | 8 | 17 | 10 | 13 |
| Liquid limit | 13 | 12 | 16 | 7 | 20 | 7 | 17 | 15 | 20 | 18 | 23 | 11 | 13 | 12 | 12 | 14 |
| Plasticity index | 20 | 20 | 26 | 13 | 26 | 8 | 24 | 24 | 35 | 22 | 32 | 22 | 22 | 18 | 22 | 22 |
| % sand | 27 | 33 | 58 | 14 | 61 | 54 | 8 | 29 | 74 | 34 | 76 | 38 | 20 | 36 | 54 | 41 |
| % silt | 10 | 8 | 10 | 10 | 16 | 13 | 28 | 30 | 14 | 10 | 20 | 11 | 12 | 14 | 20 | 15 |
| % clay | 18 | 18 | 24 | 9 | 33 | 10 | 16 | 18 | 34 | 19 | 24 | 21 | 17 | 14 | 21 | 20 |
| A Horizon pH | 10 | 7 | 3 | 8 | 9 | 13 | 7 | 10 | 2 | 7 | 11 | 14 | 7 | 10 | 11 | 9 |
| C Horizon pH | 2 | 2 | 2 | 2 | 1 | 2 | 4 | 3 | 2 | 2 | 8 | 2 | 11 | 3 | 8 | 4 |
| Organic carbon (%) | 34 | 21 | 13 | 24 | 17 | 6 | 36 | 26 | 13 | 60 | 73 | 23 | 47 | 31 | 17 | 29 |
| C Horizon carbonate (%) | 25 | 27 | 26 | 25 | 26 | 36 | 72 | 50 | 25 | 49 | 90 | 27 | 174 | 44 | 72 | 51 |
| Ahe (Ae) thickness (cm) | - | - | - | - | 47 | - | 32 | 16 | - | 38 | - | - | 41 | - | 57 | 38 |
| LFH thickness (cm) | - | - | - | - | 52 | - | 72 | 35 | - | 28 | 70 | - | 35 | - | - | 49 |
| Average CV for series | 26 | 24 | 25 | 20 | 34 | 17 | 31 | 29 | 30 | 28 | 46 | 23 | 36 | 30 | 33 | 30 |

## Appendix C. (continued)

**Table 6.** Comparison of relative values noted in this study with previously reported values

| Relative rating | Property of measurement | This study CV | This study Rank | Beckett & Webster CV | Beckett & Webster Rank | Wilding & Drees CV | Wilding & Drees Rank |
|---|---|---|---|---|---|---|---|
| Low (<15) | pH of C horizon | 4 | 1 | 14 | | 1 | 1 |
| | pH of A horizon | 10 | 1 | 12 | | 1 | 1 |
| Mod (15-29) | Liquid limit | 18 | 2 | 15 | 1 | 15-35 | 2 |
| | Plastic limit | 17 | 2 | 16 | 1 | 15-35 | 2 |
| | % silt | 20 | 2 | 27 | 1 | 21 | 2 |
| | 2nd parent material depth (cm) | 24 | 2 | - | - | - | - |
| | % clay | 27 | 2 | 27 | 1 | 24 | 2 |
| High (30-50) | Plasticity index | 29 | 3 | 35 | 2 | >35 | 3 |
| | Lime depth (cm) | 40 | 3 | 35 | 2 | 35 | 3 |
| | Organic carbon (%) | 36 | 3 | 35 | 2 | 39 | 3 |
| | B horizon thickness (cm) | 45 | 3 | 43 | 2 | >35 | 3 |
| | Ae horizon thickness (cm) | 46 | 3 | - | - | - | - |
| | Ah horizon thickness (cm) | 44 | 3 | 21 | 1 | <15 | 1 |
| Very high (>50) | % sand | 52 | 4 | 21 | 1 | 28 | 2 |
| | % slope | 54 | 4 | - | - | - | - |
| | LFH horizon thickness | 61 | 4 | - | - | - | - |
| | C horizon carbonate (%) | 57 | 4 | - | - | 26 | 2 |
| | Ahe horizon thickness | 59 | 4 | - | - | - | - |
| | C horizon Coarse fragments (%) | 75 | 4 | - | - | - | - |

*Data extracted from Beckett and Webster (1971), and Wilding and Drees (1978).

## Appendix D. Vegetation species list

**TREES**

| | |
|---|---|
| Aspen poplar | *Populus tremuloides* |
| Balsam poplar | *Populus balsamifera* |
| Black spruce | *Picea mariana* |
| Douglas fir | *Pseudotsuga menziesii* |
| Lodgepole pine | *Pinus contorta* |
| Narrowleaf cottonwood | *Populus angustifolia* |
| White birch | *Betula papyrifera* |
| White pine | *Pinus albicaulis* |
| White spruce | *Picea glauca* |

**SHRUBS**

| | |
|---|---|
| Bearberry | *Arctostaphylos uva-ursi* |
| Buffalo bean | *Astragalus crassicarpus* |
| Bunchberry | *Cornus canadensis* |
| Canadian buffaloberry | *Shepherdia canadensis* |
| Clematis | *Virginis* spp. |
| Common dandelion | *Taraxacum officinale* |
| Common plantain | *Plantago major* |
| Common yarrow | *Achillea millefolium* |
| Cow parsnip | *Heracleum lanatum* |
| Fireweed | *Epilobium angustifolium* |
| Gooseberry | *Ribes* spp. |
| Green alder | *Alnus crispa* |
| Lupine | *Lupinus* spp. |
| Meadow rue | *Thalictrum* spp. |
| Nettle | *Urtica* spp. |
| Northern bedstraw | *Galium boreale* |
| Paintbrush | *Castilleja* spp. |
| Pasture sagewort | *Artemisia frigida* |
| Prairie onion | *Allium textile* |
| Prairie sage | *Artemisia ludoviciana* |
| Prickly rose | *Rosa acicularis* |
| Puccoon | *Lithospermum* spp. |
| Red osier dogwood | *Cornus stolonifera* |
| Rough cinquefoil | *Potentilla norwegica* |
| Sagebrush | *Artemisia cana* |
| Saskatoon | *Amelanchier alnifolia* |
| Shrubby cinquefoil | *Potentilla fruticosa* |
| Smooth fleabane | *Erigeron glabellus var. pubescens* |
| Solomon's seal | *Maianthemum canadense* |
| Sticky purple geranium | *Geranium viscosissimum* |
| Swamp birch | *Betula pumila var. glandulifera* |
| Tall lungwart | *Mertensia paniculata* |
| Threeflowered avens | *Geum triflorum* |
| Trailing raspberry | *Rubus pubescens* |
| Violet | *Viola* spp. |
| Water birch | *Betula occidentalis* |
| Wild strawberry | *Fragaria virginiana* |
| Wild vetch | *Vicia americana* |
| Willow | *Salix* spp. |
| Wolf willow | *Elaeagnus commutata* |

**GRASSES**

| | |
|---|---|
| Alkali grass | *Puccinellia nuttalliana* |
| Barley | *Hordeum* spp. |
| Blue grama grass | *Bouteloua gracilis* |
| Blue grasses | *Poa* spp. |
| Columbine grasses | *Aquilegia brevistyla* |
| Flax | *Linum usitatissimum* |
| Foxtail barley | *Hordeum jubatum* |
| Hair grass | *Deschampsia caespitosa* |
| Hooker's oat grass | *Helictotrichon hookeri* |

## Appendix D. (continued)

| **GRASSES** (continued) | |
|---|---|
| Idaho fescue | *Festuca idahoensis* |
| Interior blue grass | *Poa interior* |
| June grass | *Koeleria enstata* |
| Kentucky blue grass | *Poa pratensis* |
| Manna grass | *Glyceria* spp. |
| Oats | *Avena* spp. |
| Parry's oat grass | *Danthonia parryi* |
| Porcupine grass | *Stipa spartea* |
| Rapeseed | *Brassica napus* |
| Reed grass | *Calamagrostis* spp. |
| Rough fescue | *Festuca scabrella* |
| Rye | *Secale* spp. |
| Salt grass | *Distichlis stricta* |
| Slough grass | *Beckmannia syzigachne* |
| Smooth brome | *Bromus inermis* |
| Spear grass | *Sponotolus comata* |
| Timothy | *Phleum pratense* |
| Wheat | *Triticum* spp. |
| Wheat grass | *Agropyron* spp. |

# Appendix E. Complete symbol and descriptive legends for all soil units within the map area.

### Key to Calgary urban perimeter soil survey legend symbols

**Parent material codes**

| Symbol | Explanation |
|---|---|
| COL | Colluvium |
| EOL | Aeolian |
| FG | Glaciofluvial |
| FL | Recent Fluvial |
| LG | Glaciolacustrine |
| LAC | Recent Lacustrine |
| PT | Peat |
| R | Rock |
| TILL, TIL, L | or Till<br>Lacustrine |

**Soil classification codes**

| Symbol | Subgroup classification |
|---|---|
| BRGL | Brunisolic Gray Luvisol |
| BLSS | Black Solodized Solonetz |
| BLSZ | Black Solonetz |
| CUHR | Cumulic Humic Regosol |
| DGL | Dark Gray Luvisol |
| EBL | Eluviated Black (Chernozemic) |
| EEB | Eluviated Eutric Brunisol |
| GLBL | Gleyed Black (Chernozemic) |
| GLBLSS | Gleyed Black Solodized Solonetz |
| GLBSZ | Gleyed Black Solonetz |
| GLHR | Gleyed Humic Regosol |
| HULG | Humic Luvic Gleysol |
| OBL | Orthic Black (Chernozemic) |
| ODG | Orthic Dark Gray (Chernozemic) |
| OEB | Orthic Eutric Brunisol |
| OGL | Orthic Gray Luvisol |
| OHG | Orthic Humic Gleysol |
| OHR | Orthic Humic Regosol |
| OLG | Orthic Luvic Gleysol |
| OR | Orthic Regosol |
| RBL | Rego Black |
| RHG | Rego Humic Gleysol |
| TM | Terric Mesisol |

**Landscape codes**

| Symbol | Explanation |
|---|---|
| BI | Bog level |
| CV | Colluvial veneer |
| EV | Eolian veneer |
| FL-V | Recent fluvial, level-gullied |

**Landscape codes** (continued)

| Symbol | Explanation |
|---|---|
| FF | Recent fluvial, fan |
| FT | Recent fluvial, terrace |
| FV | Recent fluvial, veneer |
| FGF | Glaciofluvial, fan |
| FGH | Glaciofluvial, hummocky |
| FGI-S | Glaciofluvial, inclined-steep |
| FGL | Glaciofluvial, level |
| FGL-U | Glaciofluvial, level to undulating |
| FGL-V | Glaciofluvial, level to gullied |
| FGM | Glaciofluvial, rolling |
| FGR | Glaciofluvial, ridged |
| FGR-I | Glaciofluvial, ridged to inclined |
| FGT | Glaciofluvial, terrace |
| FGU-M | Glaciofluvial, undulating to rolling |
| FGV | Glaciofluvial, veneer |
| FGV-R | Glaciofluvial, veneer-ridged |
| LB | Recent lacustrine, blanket |
| LV | Recent lacustrine, veneer |
| LGB | Glaciolacustrine, blanket |
| LGBV | Glaciolacustrine, blanket to veneer |
| LGH | Glaciolacustrine, hummocky |
| LGI | Glaciolacustrine, inclined |
| LGL | Glaciolacustrine, level |
| LGL-U | Glaciolacustrine, level to undulating |
| LGM | Glaciolacustrine, rolling |
| LGU | Glaciolacustrine, undulating |
| LGV | Glaciolacustrine, veneer |
| MB | Morainal, blanket |
| MBV | Morainal, blanket to veneer |
| MH | Morainal, hummocky |
| ML | Morainal, level |
| ML-V | Morainal, level-gullied |
| MM | Morainal, rolling |
| MR | Morainal, ridged |
| MU | Morainal, undulating |
| MU-V | Morainal, undulating-gullied |
| MV | Morainal, veneer |
| RI | Rock, inclined |
| RI-S | Rock, inclined to steep |
| RL | Rock, level |
| RL-R | Rock, level to ridged |
| RL-V | Rock, level-gullied |
| RR | Rock, ridged |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | Parent material and surface form | Soil composition and comments |
|---|---|---|---|---|
| Academy | ADHP1 | 1 | Mostly fine loamy till; scattered patches of variable thickness, coarse loamy, glaciofluvial veneer; undulating to gently rolling | Mostly well-drained Black Chernozemics. Surface veneer is patchy and till predominates at the surface. |
| Academy | ADHP2 | 1 | Mostly fine loamy till with discontinuous coarse loamy glaciofluvial veneer and some deeper glaciofluvial ridges; ridged | Mostly well-drained Black Chernozemics. Weakly developed and thin profiles common on the ridges, poorly drained Humic Gleysols are found in the swales. |
| Academy | ADHP3 | 1 | Mixture of fine loamy till and coarse loamy glaciofluvial; ridged | Well-drained Black Chernozemics. Weakly developed and thin profiles common. Ridges are fluted eskers. Sand and gravel are incorporated into the till. Ridges often have sand cores. |
| Antler | ATL1 | 2H | Fine loamy till; undulating to gently rolling | Well-drained Black Chernozemics. Mapped on smooth uniform topography. |
| Antler | ATL2 | 2H | Fine loamy till; undulating to gently rolling | Well-drained Black Chernozemics with poorly drained Humic Gleysols in scattered wet depressions. |
| Antler | ATL3 | 2H | Blanket to veneer of fine loamy till draped over bedrock; inclined to rolling | Well-drained Black Chernozemics. Mapped on bedrock controlled slopes. Surface runoff contributes to erosion and accumulation of slopewash. Bedrock often occurs between 50 and 300 cm. |
| Antler | ATL5 | 2H | Fine loamy till; undulating, ridged, hummocky | Well-drained Black Chernozemics, rougher topography results in more weakly developed, thin and eroded profiles than in ATL1. |
| Balzac | BZC1 | 1 | Fine clayey recent lacustrine overlying till, level to depressional | Poorly drained Saline Humic Gleysols. Mapped in low-lying areas of groundwater discharge. |
| Balzac | BZC2 | 1 | Fine clayey recent lacustrine; till or coarse loamy veneer overlying till at unit margins; level to inclined | Poorly drained Saline Humic Gleysols. Mapped in sinuous drainage channels. Soils at margins are better drained and may be Solonetzic. Usually developed on till but may be somewhat sandy. |
| Balzac | BZC3 | 1 | Fine clayey recent lacustrine overlying till; level to undulating | Poorly drained Saline Humic Gleysols with scattered better drained Black Chernozemics. |
| Balzac | BZC4 | 1 | Thin discontinuous fine clayey recent lacustrine overlying till; undulating to depressional | Variable mixture of poorly drained Saline Humic Gleysols, well drained Black Chernozemics, and well to imperfectly drained Solodized Solonetz. Mapped in low-lying groundwater discharge areas with minor better drained knolls. |
| Bearspaw | BPW1 | 2H | Fine silty glaciolacustrine; hummocky | Well-drained Black Chernozemics. Weakly developed and eroded profiles predominate. Rougher topography results in rapid surface runoff and significant erosion. |
| Beddington | BED1 | 1 | Fine loamy till; level to inclined | Mostly well to imperfectly drained Solodized Solonetz. Dense hardpan occurs between 12 and 17 cm. |
| Beddington | BED2 | 1 | Fine loamy till; undulating to inclined | Mixture of well to imperfectly drained Solodized Solonetz and well-drained Black Chernozemics. Hardpan distribution irregular. |
| Beddington | BED3 | 1 | Fine loamy till; low-lying, depressional to undulating | Variable mixture of well to imperfectly drained Solodized Solonetz, well-drained Black Chernozemics and poorly drained saline Humic Gleysols. Solonetzic soils predominate. |
| Bow Valley | BOV1 | 2H | Loamy skeletal glaciofluvial (gravel) overlain by a thin fine loamy fluvial veneer; level to inclined terraces | Rapidly drained Black Chernozemics. Surface often very stony. |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | Parent material and surface form | Soil composition and comments |
|---|---|---|---|---|
| Bow Valley | BOV2 | 2H | Thin loamy skeletal glaciofluvial veneer overlying till or fine silty glaciolacustrine; inclined to steep | Rapidly drained Black Chernozemics or Regosols. Mapped on steeply sloping, stony and cobbly escarpments and ridges. |
| Bragg Creek | BRG1 | 5H | Coarse loamy fluvial veneer overlying loamy skeletal glaciofluvial; level to undulating floodplains and terraces | Rapidly drained Eutric Brunisols and Gray Luvisols. Lower terraces and floodplains may have high water tables. |
| Connop | CON1 | 5H | Coarse to loamy to sandy glaciofluvial; level to undulating | Rapidly drained Eutric Brunisols and Gray Luvisols. Sand grains are dolomitic. |
| Delacour | DEL1 | 1 | Fine loamy till; level to gently rolling | Well-drained Black Chernozemics. Isolated patches of surface salts may occur. |
| Delacour | DEL2 | 1 | Fine loamy till, low-lying; undulating to hummocky | Well-drained Black Chernozemics with poorly drained Saline Humic Gleysols in scattered wet depressions. isolated surface salt patches. |
| Delacour | DEL3 | 1 | Fine loamy till; low-lying, undulating to hummocky | Well-drained Black Chernozemics with numerous poorly drained Saline Humic Gleysols in wet depressions. Frequent surface salt patches. |
| Delacour | DEL4 | 1 | Fine loamy till; undulating, inclined or rolling | Well-drained Black Chernozemics with scattered patches of well to imperfectly drained Solodized Solonetz. |
| Delacour | DEL5 | 1 | Fine loamy till with patches of fine clayey recent lacustrine in depressions; low-lying, undulating to hummocky | Variable mixture of well-drained Black Chernozemics, well to imperfectly drained Solodized Solonetz and poorly drained Saline Humic Gleysols. Mapped in low-lying areas of groundwater discharge. |
| Delacour | DEL6 | 1 | Fine loamy till; level to hummocky | Well-drained Black Chernozemics with numerous poorly drained Humic Gleysols in scattered wet depressions. Depressions are local groundwater recharge sites. |
| Delacour | DEL7 | 1 | Fine loamy till; undulating, hummocky or ridged | Well-drained Black Chernozemics. Rougher topography results in more weakly developed, thin and eroded profiles than in DEL1. |
| Delacour | DEL8 | 1 | Fine loamy till with some fine loamy recent fluvial; inclined and level | Mostly well-drained Black Chernozemics. Mapped in sinuous drainage channels. Imperfectly to poorly drained soils developed on Alluvium occur along the channel floors. |
| Delacour | DEL9 | 1 | Fine loamy till blanket overlying sandy glaciofluvial; ridged | Well-drained Black Chernozemics. Mapped on till ridges thought to have sandy cores (draped eskers). |
| Delacour | DERK1 | 1 | Mostly fine loamy till overlain by scattered patches of fine silty eolian veneer; level to undulating | Well-drained Black Chernozemics. Silty veneer is patchy and till predominates at the surface. |
| Delacour | DERK2 | 1 | Mostly fine loamy till overlain by scattered patches of fine silty eolian veneer; level to undulating | Well-drained Black Chernozemics with significant poorly drained Humic Gleysols in scattered wet depressions. |
| DeWinton | DWHP1 | 2H | Mixture of fine clayey recent lacustrine in depressions and coarse loamy glaciofluvial occupying high spots; undulating to depressional | Poorly drained Humic Gleysols with scattered better-drained Black Chernozemics. |
| DeWinton | DWT1 | 2H | Fine clayey recent lacustrine often overlying fine loamy till; level to depressional | Poorly drained Humic Gleysols. Mapped in low-lying areas of local groundwater discharge or slow recharge. |
| DeWinton | DWT2 | 2H | Fine clayey recent lacustrine veneer to blanket overlying sandstone bedrock; level to depressional | Poorly drained Humic Gleysols with significant lithic phases. Bedrock often occurs between 50 and 150 cm. |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | Parent material and surface form | Soil composition and comments |
|---|---|---|---|---|
| DeWinton | DWT3 | 2H | Thin veneer of mesic peat overlying fine clayey recent lacustrine which may rest on fine loamy till or recent fluvial; depressional | Poorly drained peaty Gleysols and very poorly drained Terric Mesisols. Mapped in wet drainage channels. |
| Dunvargan | DVFS1 | 3H | Complex mixture of fine loamy till and fine clayey glaciolacustrine; hummocky | Well-drained Black Chernozemics. No consistent pattern to the distribution of till and glaciolacustrine parent materials. |
| Dunvargan | DVFS2 | 3H | Complex mixture of fine loamy till and fine clayey glaciolacustrine; hummocky | Well-drained Black Chernozemics and Dark Gray Luvisols. No consistent pattern to the distribution of till and glaciolacustrine parent materials. |
| Dunvargan | DVG1 | 3H | Fine loamy till; undulating to gently rolling | Well-drained Black Chernozemics. Till is fine clayey in places. |
| Dunvargan | DVG2 | 3H | Fine loamy till; undulating to hummocky | Well-drained Black Chernozemics with poorly drained Humic Gleysols in scattered wet depressions. More weakly developed, thin and eroded profiles than in DVG1. |
| Dunvargan | DVG3 | 3H | Blanket to veneer of fine loamy till draped over bedrock; inclined to rolling | Well-drained Black Chernozemics. Mapped on bedrock controlled slopes. Surface runoff contributes to erosion and accumulation of slopewash. Bedrock often occurs between 50 and 300 cm. |
| Dunvargan | DVG4 | 3H | Fine loamy till; undulating to hummocky | Well-drained Black Chernozemics. Rougher topography results in more weakly developed, thin and eroded profiles than in DVG1. |
| Eastbow | EBAD1 | 1 | Thin, continuous, fine silty eolian veneer overlying thin discontinuous coarse loamy glaciofluvial veneer resting on fine loamy till; level to gently rolling | Well to rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. |
| Eastbow | EBAD2 | 1 | Thin, continuous, fine silty eolian veneer overlying thin discontinuous coarse loamy glaciofluvial veneer resting on fine loamy till; undulating to depressional | Well to rapidly drained Black Chernozemics with significant poorly drained Humic Gleysols in scattered wet depressions. Weakly developed and eroded profiles predominate. |
| Elbow | ELRS1 | 5H | Variable thickness fine clayey glaciolacustrine veneer overlying fine clayey till; undulating to gently rolling | Moderately well-drained Dark Gray and Gray Luvisols. Till and glaciolacustrine parent materials and similar in appearance and properties. |
| Elbow | ELRS2 | 5H | Fine clayey glaciolacustrine veneer overlying fine clayey till overlying gravels resting on bedrock; level to undulating | Moderately well-drained Dark Gray and Gray Luvisols. Gravel or bedrock are often found within 100 to 200 cm of the surface. |
| Elbow | ELRS3 | 5H | Fine clayey glaciolacustrine or fine clayey till blanket to veneer draped over bedrock; inclined to steep | Well-drained Dark Gray and Gray Luvisols. Mapped on bedrock controlled slopes. Bedrock usually more than 200 cm below the surface. |
| Elbow | ELRS4 | 5H | Thin discontinuous, fine clayey glaciolacustrine veneer overlying fine clayey till blanket resting on sandy glaciofluvial; undulating to hummocky | Moderately well-drained Dark Gray and Gray Luvisols with some poorly drained Gleysols. Sand underlies most of the unit and occasionally occurs at the surface. |
| Fish Creek | FSH1 | 3H | Very fine clayey glaciolacustrine; undulating to gently rolling | Moderately well-drained Black Chernozemics. Slowly permeable. |
| Fish Creek | FSH2 | 3H | Very fine clayey glaciolacustrine; undulating to hummocky | Moderately well-drained Black Chernozemics with poorly drained Humic Gleysols in scattered wet depressions. Slowly permeable. |
| Fish Creek | FSH3 | 3H | Very fine clayey glaciolacustrine blanket to veneer overlying till; undulating to hummocky | Moderately well-drained Black Chernozemics. Till subsoil often fine clayey. Slowly permeable. |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | Parent material and surface form | Soil composition and comments |
|---|---|---|---|---|
| Fish Creek | FSH4 | 3H | Very fine clayey glaciolacustrine blanket to veneer overlying till; undulating to hummocky | Moderately well-drained Black Chernozemics with poorly drained Humic Gleysols in scattered wet depressions. Till subsoil often fine clayey. Slowly permeable. |
| Fish Creek | FSH5 | 5H | Very fine clayey glaciolacustrine; undulating to gently rolling | Moderately well-drained Black Chernozemics and Dark Gray Luvisols. Slowly permeable. Mapped in climate zone 5H. |
| Happy Valley | HPAD1 | 1 | Mostly continuous, coarse loamy glaciofluvial veneer overlying till with scattered patches of fine silty eolian surface veneer; nearly level to gently inclined | Well to rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. Till occurs at 50 to 150 cm throughout most of the unit. |
| Happy Valley | HPAD3 | 1 | Complex mixture of coarse loamy to sandy glaciofluvial and fine loamy till; hummocky | Well to rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. Hummocky topography disrupts many uses of this unit. |
| Happy Valley | HPAD4 | 1 | Coarse loamy to sandy glaciofluvial blanket to veneer draped over till; scattered patches of fine silty, eolian surface veneer; inclined to steep | Well to rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. Mapped on escarpments adjacent to meltwater channels and stream valleys. |
| Happy Valley | HPSC1 | 1 | Mixture of coarse loamy to sandy glaciofluvial and lenses, channels or fans of glaciofluvial gravel; level, inclined or terraced | Rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. Location of gravel is unpredictable. |
| Happy Valley | HPV1 | 1 | Coarse loamy to sandy glaciofluvial or glaciolacustrine with thin discontinuous fine silty eolian surface veneer; nearly level to undulating. | Rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. Soils are susceptible to wind erosion. |
| Happy Valley | HPV2 | 1 | Coarse loamy to sandy glaciofluvial or glaciolacustrine with thin discontinuous fine silty eolian surface veneer; inclined, ridged and sloping | Rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. Mapped on steeper topography than HPV1 and is more strongly eroded. |
| Happy Valley | HPV3 | 1 | Coarse loamy to sandy glaciofluvial or glaciolacustrine with thin discontinuous fine silty eolian surface veneer; hummocky | Rapidly drained Black Chernozemics. Weakly developed and eroded profiles predominate. Hummocky topography contributes to erosion and disrupts many uses of this unit. |
| Highwood | HIBO1 | 1 | Thin discontinuous coarse loamy to sandy glaciofluvial veneer overlying glaciofluvial gravels; nearly level to inclined terraces | Rapidly drained Black Chernozemics. Weakly developed and calcareous profiles predominate. Underlying gravel is well rounded and well sorted. |
| Highwood | HIW1 | 1 | Coarse loamy to sandy glaciofluvial and fluvial; level to inclined terraces | Rapidly drained Black Chernozemics and Humic Regosols. Gravel frequently occurs below 200 to 400 cm. |
| Indus | IND1 | 1 | Fine loamy till, occasional fine silty lacustrine or eolian veneer; level to depressional. | Poorly drained Humic Gleysols. Depressions are sites of slow local groundwater recharge. |
| Indus | IND2 | 1 | Fine loamy till, occasional patches of fine silty lacustrine or eolian veneer in depressions; undulating to slightly hummocky | Poorly drained Humic Gleysols with significant better-drained Black Chernozemics on knolls. Eluviation in Gleysols indicates occurrence of groundwater recharge in depressions. |
| Leighton Centre | LTC1 | 3H | Fine loamy till blanket to veneer draped over bedrock; inclined, ridged and steep | Well-drained Dark Gray and Gray Luvisols with occasional Eutric Brunisols. Also contains lithic soils and slope wash. |
| Leighton Centre | LTC2 | 3H | Fine loamy till; nearly level to gently undulating | Well-drained Dark Gray and Gray Luvisols. Cultivation incorporates original surface layers into a dark gray plough layer. |
| Lloyd Lake | LLK1 | 1 | Fine silty to fine clayey glaciolacustrine; nearly level to gently undulating | Well-drained Black Chernozemics. Very silty subsoil. |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | Parent material and surface form | Soil composition and comments |
|---|---|---|---|---|
| Lloyd Lake | LLK2 | 1 | Fine silty to fine clayey glaciolacustrine; nearly level to gently undulating | Moderately well-drained Black Chernozemics and Solodized Solonetz with poorly drained Saline Humic Gleysols in scattered wet depressions. Bedrock often occurs at from 150 to 300 cm. |
| Lloyd Lake | LLK3 | 1 | Fine silty to fine clayey glaciolacustrine often as blanket to veneer overlying till; inclined to steep | Well to rapidly drained Black Chernozemics. Mapped on escarpments and hillsides. Surface runoff contributes to erosion, accumulation of slopewash and thin profiles. |
| Lloyd Lake | LLK4 | 1 | Fine silty to fine clayey glaciolacustrine blanket overlying glaciofluvial gravel; level to inclined terraces | Well-drained Black Chernozemics. Unit consists of coalescing fans of glaciofluvial material overlying gravel. |
| Mesa Butte | MSB1 | 5H | Fine loamy to loamy skeletal colluvial veneer overlying sandstone or shale bedrock; ridged, steep | Mixture of well to rapidly drained Black Chernozemics and Eutric Brunisols. Lithic phases and thin profiles predominate. Bedrock often occurs between 50 and 150 cm. Slopes show evidence of recent soil creep. |
| Midnapore | MD-L1 | 2H | Coarse loamy to sandy glaciofluvial or weathered residual veneer overlying sandstone bedrock; level, inclined or ridged | Well-drained lithic Black Chernozemics. Depth to bedrock usually less than 100 cm. |
| Midnapore | MDAD1 | 1 | Mostly continuous, coarse loamy to sandy glaciofluvial veneer overlying till with scattered patches of fine silty eolian surface veneer; nearly level to gently rolling | Well-drained Black Chernozemics. Till generally at from 50 to 200 cm. |
| Midnapore | MDP1 | 1 | Coarse loamy to sandy glaciofluvial or glaciolacustrine with thin discontinuous fine silty eolian surface veneer; nearly level to gently rolling | Well-drained Black Chernozemics. Deep well-developed profiles. |
| Midnapore | MDP2 | 1 | Coarse loamy to sandy glaciofluvial or glaciolacustrine with thin discontinuous fine silty eolian surface veneer; undulating to hummocky | Well-drained Black Chernozemics with poorly drained Humic Gleysols in scattered wet depressions. Subsoil becomes sandier with depth. |
| Nose Creek | NSK1 | 2H | Fine loamy to loamy skeletal till with some fine loamy recent fluvial and weathered bedrock; level to inclined bevelled terraces | Well-drained Black Chernozemics. Subsoils often saline and bedrock generally less than 200 cm below the surface. |
| Nose Creek | NSK2 | 2H | Fine loamy to loamy skeletal till with considerable recent fluvial reworking and occasional weathered bedrock to surface; level floodplains and lower terraces, channeled and gullied | Well to moderately well-drained Black Chernozemics and Regosols. Also contains alluvium in active or abandoned drainage channels. Bedrock generally less than 200 cm below the surface. |
| Nose Creek | NSK3 | 2H | Fine loamy to loamy skeletal till with recent fluvial reworking of surface and numerous depressions infilled with fine clayey recent lacustrine; level to inclined, bevelled terraces | Well to moderately well-drained Black Chernozemics with imperfectly drained Solodized Solonetz and poorly drained Saline Humic Gleysols found in the clay infilled depressions. Bedrock generally less than 200 cm below the surface. |
| Organics | TM1 | 5H | Variable thickness veneer of mesic peat overlying undifferentiated mineral sediments; level to depressional | Very poorly drained Mesisols. Generally mapped in narrow valley floors. High water tables and permanently wet soils. |
| Pothole Creek | POT1 | 5H | Fine to very fine clayey recent lacustrine or glaciolacustrine; level to depressional | Poorly drained Humic Gleysols. Mapped in depressions. |
| Pothole Creek | POT2 | 5H | Fine to very fine clayey recent lacustrine or glaciolacustrine; undulating to depressional | Poorly drained Humic Gleysols with better drained Black Chernozemics on scattered knolls. |
| Pothole Creek | POT3 | 5H | Fine to very fine clayey recent lacustrine or glaciolacustrine with inclusions of variable textured recent fluvial; level to undulating | Mixture of poorly drained Humic Gleysols and better drained Black Chernozemics. Mapped along natural drainage ways in basins and valleys. |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | Parent material and surface form | Soil composition and comments |
|---|---|---|---|---|
| Rockyview | RKAD1 | 1 | Variable thickness, discontinuous fine silty eolian veneer overlying fine loamy till; undulating to gently rolling | Well-drained Black Chernozemics. Silty veneer appears to be loess. |
| Rockyview | RKAD2 | 1 | Variable thickness, discontinuous fine silty eolian veneer overlying fine loamy till; undulating to gently rolling | Well-drained Black Chernozemics with significant poorly drained Humic Gleysols in scattered wet depressions. |
| Rockyview | RKAD3 | 1 | Remnants of a thin discontinuous fine silty eolian veneer overlying a blanket of fine loamy till draped over bedrock; inclined to steep | Well-drained Black Chernozemics. Mapped on bedrock controlled slopes. Surface runoff contributes to erosion and accumulation of slopewash. Bedrock often occurs between 100 and 500 cm. |
| Rockyview | RKAD4 | 1 | Variable thickness, discontinuous, fine silty eolian veneer overlying fine loamy till; undulating to gently rolling | Well-drained Black Chernozemics with scattered patches of well to imperfectly drained Solodized Solonetz. |
| Rockyview | RKAD5 | 1 | Thin, discontinuous, fine silty eolian veneer overlying fine loamy till; undulating to hummocky | Well-drained Black Chernozemics. Rougher topography results in more weakly developed, thin and eroded profiles than in RKAD1. |
| Rough Broken | RB1 | all | Fine loamy till; inclined to steeply sloping | Undifferentiated soils. Mapped on steep escarpments adjacent to active stream and river channels. Bedrock generally more than 200 cm below the surface. |
| Rough Broken | RB2 | all | Highly variable, mainly fine loamy colluvium or colluviated till veneer overlying sandstone or shale bedrock; steeply sloping | Undifferentiated soils. Mapped on steep, thinly covered bedrock escarpments adjacent to active drainage channels. Down slope creep often in evidence. |
| Rough Broken | RB4 | all | Fine loamy till with occasional patches of fine loamy alluvium in central drainage channel; inclined to steeply sloping; gullied | Undifferentiated soils. Mapped in V-shaped intermittent drainage ways and gullies. Steep rapidly drained sides bound imperfectly to poorly drained central drainage channel. |
| Rough Broken | RB5 | all | Fine silty to fine clayey glaciolacustrine; inclined to steeply sloping | Undifferentiated soils. Mapped on steep escarpments separating different levels of glaciolacustrine terraces. Erosion and gullying frequently expose subsoil. |
| Sarcee | SRC1 | 3H | Fine to coarse loamy recent fluvial; level to inclined upper terraces | Well to moderately well-drained Black Chernozermics. Mapped on undisected upper terraces. |
| Sarcee | SRC2 | 3H | Fine to coarse loamy recent fluvial; level to undulating lower terraces and floodplains; dissected and gullied | Range from well-drained Black Chernozemics to very poorly drained peaty Gleysols. Strongly dissected by active and abandoned drainage channels. |
| Sarcee | SRC3 | 3H | Fine to coarse loamy recent fluvial veneer to blanket overlying glaciofluvial gravel; level to inclined upper terraces | Well to moderately well-drained Black Chernozemics. Mapped on undissected upper terraces. Gravel underlies Alluvium at 50 to 200 cm. |
| Sarcee | SRC4 | 3H | Fine to coarse loamy recent fluvial veneer to blanket overlying glaciofluvial gravel; level to undulating lower terraces and floodplains dissected and gullied | Well-drained Black Chernozemics to very poorly drained peaty Gleysols. Strongly dissected by active and abandoned drainage channels. Gravel underlies Alluvium at 50 to 200 cm. |
| Spruce Ridge | SPR1 | 5H | Fine loamy to loamy skeletal till blanket to veneer overlying bedrock; ridged, inclined or steep | Well-drained Gray Luvisols or Eutric Brunisols. Lithic soils and slope wash are common. |
| Spruce Ridge | SPR2 | 5H | Fine loamy to loamy skeletal till blanket to veneer overlying bedrock; ridged, inclined or steep | Well-drained Gray Luvisols or Eutric Brunisols with significant amounts of Dark Gray Luvisols. Often mapped on south or west sides of ridges. |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | Parent material and surface form | Soil composition and comments |
|---|---|---|---|---|
| Spy Hill | SPY1 | 3H | Fine loamy to loamy skeletal till; hummocky | Thin, stony, well-drained Black and Dark Gray Chernozemics. Hummocky topography disrupts many uses. A gravelly phase (GV) is mapped where gravel is believed to occur below the normal depth of investigation. |
| Spy Hill | SPY2 | 3H | Fine loamy to loamy skeletal till; hummocky | Thin, stony, well-drained Black and Dark Gray Chernozemics with significant poorly drained Humic Gleysols. Hummocky topography and wet depressions disrupt many uses. |
| Strathcona | SCO1 | 2H | Poorly sorted angular glaciofluvial gravels with a thin fine loamy fluvial surface veneer; level, inclined or steeply sloping | Rapidly drained Black Chernozemics. Mapped on various landforms including fans, deltas, eskers, crevasse fillings, and kames. |
| Strathcona | SCO2 | 2H | Thin, fine loamy fluvial veneer overlying sandy skeletal to sandy glaciofluvial; undulating rolling ridged or inclined | Rapidly drained Black Chernozemics. Subsoil may be mixed sand and gravel or separate lenses of sand and gravel. Mapped mainly on eskers or in meltwater channels. |
| Strathcona | SCO3 | 2H | Thin fine loamy fluvial veneer overlying sandy skeletal to sandy glaciofluvial blanket to veneer resting on till or bedrock; level to undulating | Well to imperfectly drained Black Chernozemics. Mapped in scoured glacial meltwater channels. Patchy distribution of thin gravel or sandy gravel resting on till or bedrock. Lithic soils are common. |
| Sundre | SUD1 | 5H | Thin, fine loamy fluvial veneer overlying well-sorted glaciofluvial gravels; level to inclined terraces | Well to rapidly drained Dark Gray Chernozemics. Mapped on outwash gravels along streams and rivers in the foothills. |
| Terric Mesisol | TM1 | 5H | 100 to 150 cm of mesic peat overlying undifferentiated mineral material | Very poorly drained Terric Mesisol organic soils. Mapped in wet, level valley bottoms. |
| Tweeds-muir | TWS1 | 2H | Fine to coarse loamy recent fluvial; level to inclined upper terraces | Well to moderately well-drained Black Chernozemics and Humic Regosols. Mapped on undisected upper terraces. |
| Tweeds-muir | TWS2 | 2H | Fine to coarse loamy recent fluvial; level to undulating lower terraces and floodplains; disected and gullied | Well-drained Black Chernozemics to poorly drained Humic Gleysols. Strongly dissected by active and abandoned drainage channels. |
| Twin Bridges | TBR1 | 3H | Sandy to coarse loamy recent fluvial mixed with channels, ribbons and bars of glaciofluvial gravel; level to inclined, disected and gullied with minor ridges | Imperfectly drained Regosols and Humic Regosols with poorly drained Humic Gleysols and rapidly drained Regosols on gravel. Gravel exposed in a braided pattern at the surface and generally occurs below 200 cm. Water table often within 150 cm of the surface. |

**Symbol legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | PM | Landform | Slope | Drainage | Major soils | Minor soils |
|---|---|---|---|---|---|---|---|---|
| Academy | ADHP1 | 1 | FG/TILL | FGV/MU | C,D | well | ADY OBL 30-50<br>HPV RBL 20-40 | EDBO RBL 10-30<br>RKV OBL 10-30<br>SHL RBL 0-20 |
| Academy | ADHP2 | 1 | FG/TILL | FGV-R/MR | D | well to rapid sig. poorly drained | ADY OBL 20-40<br>HPV RLB 20-40 | DWT RHG 10-30<br>EBO RBL 10-30<br>RKV OBL 10-30 |
| Academy | ADHP3 | 1 | FG-TILL | FGR-MR | D,E,F | well to rapid, Surface runoff reduces infiltration | ADY OBL 20-40<br>HPV RBL 20-40 | SCO OBL 0-20<br>EBO RBL 0-20<br>RKV OBL 0-20<br>SHL RBL 0-20 |
| Antler | ATL1* | 2H | TILL | MU-MM | C,D,E | well | ATL OBL 79-96 | RBL 4-21 |
| Antler | ATL2 | 2H | TILL | MU-MH | C,D | well sig poorly drained | ATL OBL 50-70 | DWT RHG 10-30<br>RBL 10-30 |

## Appendix E. (continued)

**Symbol legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | PM | Landform | Slope | Drainage | Major soils | Minor soils |
|---|---|---|---|---|---|---|---|---|
| Antler | ATL3 | 2H | TILL/R | MBV/R | D,E,F | well to rapid, surface runoff reduces infiltration | ATL OBL 30-50<br>RBL 10-30 | Lithic phases slope wash |
| Antler | ATL5 | 2H | TILL | MH-MR | C,D,E | well, minor poorly drained | ATL OBL 20-40<br>RBL 20-40 | DWT RHG 0-15 eroded phases |
| Balzac | BZC1 | 1 | LAC/TILL | LV/ML | A | poorly drained, GW discharge | BZC RHG 70-90 | GLBLSZ 5-15<br>GLBL 5-15 |
| Balzac | BZC2 | 1 | LAC/TILL | LV/ML-V | B,D | poorly drained, sinuous channels | BZC RHG 50-70 | GLBL 10-30 sandy gleyed or solonetzic soils |
| Balzac | BZC3 | 1 | LAC/TILL | LV/MU | B | poorly, some better drained knolls | BZC RHG 60-80 | DEL OBL 10-30<br>GLBL 0-20 |
| Balzac | BZC4 | 1 | LAC/TILL | LV/MU | B,C | poorly, some better drained knolls | BZC RHG 30-50 | DEL OBL 20-40<br>BED BLSS 20-40 |
| Bearspaw | BPW1 | 2H | LG | LGH | D | well | BPW RBL 40-60<br>LLK OBL 20-40 | DWT RHG 0-15 eroded phases |
| Beddington | BED1 | 1 | TILL | MU-MM | C | moderately well, some discharge | BED BLSS 70-90 | DEL OBL 0-30<br>ADY OBL 0-30 |
| Beddington | BED2 | 1 | TILL | MU-MM | C | moderately well, some discharge | BED BLSS 30-50<br>DEL OBL 30-50 | BLSZ 10-30 |
| Beddington | BED3 | 1 | TILL | ML-MH | C | moderately well, sig poorly drained | BED BLSS 30-50 | BZC RHG 20-40<br>DEL OBL 20-40 |
| Bow Valley | BOV1 | 2H | FG | FGT-FGL | B,C | rapid internal drainage | BOV OBL 70-90 | TWS OBL 0-20<br>HIW RBL 0-20 |
| Bow Valley | BOV2 | 2H | FG | FGI-S | F | well to rapid, surface runoff reduces infiltration | BOV OBL 30-50<br>GV OHR 20-40 | RBL 10-20<br>BPW RBL 10-20 |
| Bragg Creek | BRG1 | 5H | FG | FGL-U | C | rapidly | BRG EEB 50-70<br>BRGL 20-40 | gleysols and gleyed soils 0-20 |
| Connop | CON1 | 5H | FG | FGU-M | D | rapidly | CON EEB 60-80<br>BRGL 20-40 | SPR OGL 0-20<br>RSN DGL 0-20<br>ELB DGL 0-20 |
| Delacour | DEL1* | 1 | TILL | MU-ML | B,C,D | well | DEL OBL 62-85<br>RKV OBL 7-25 | SHL RBL 0-10<br>BZC RHG 0-10 |
| Delacour | DEL2 | 1 | TILL | MU-MH | C | well, minor poorly drained | DEL OBL 50-70 | BZC RHG 10-30<br>SHL RBL 10-30 |
| Delacour | DEL3 | 1 | TILL | MU-MH | C | well, sig poorly drained | DEL OBL 30-50<br>BZC RHG 30-50 | SHL RBL 10-30 |
| Delacour | DEL4 | 1 | TILL | MU-MM | C | well | DEL OBL 50-70 | BED BLSS 10-30<br>SHL RBL 10-30 |
| Delacour | DEL5 | 1 | TILL | ML-MU | C | well, sig poorly and mod well | DEL OBL 30-50 | BZC RHG 20-40<br>BED BLSS 20-40 |
| Delacour | DEL6 | 1 | TILL | ML-MH | B,C | well, sig poorly drained, local recharge | DEL OBL 50-70<br>IND HULG 15-45 | RBL 0-20 |
| Delacour | DEL7 | 1 | TILL | MH-MR | C,D | well, minor poorly drained | DEL OBL 40-60<br>SHL RBL 30-50 | gleyed soils |
| Delacour | DEL8 | 1 | TILL | MU-V | D,B | well, wet central drainage channel | DEL OBL 40-60<br>SHL RLB 10-30 | gleyed soils<br>alluvial soils |

## Appendix E. (continued)

**Symbol legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | PM | Landform | Slope | Drainage | Major soils | Minor soils |
|---|---|---|---|---|---|---|---|---|
| Delacour | DEL9 | 1 | TILL/FG | MBV/FGR | D,E | well to rapid surface runoff reduces infiltration | DEL OBL 40-60<br>SHL RBL 20-40 | EBO RBL 10-30<br>sandy variants |
| Delacour | DERK1 | 1 | EOL/TILL | EV/MU | B,C,D | well | DEL OBL 40-60<br>RKV OBL 20-40 | EBO RBL 0-20<br>MDP OBL 0-20 |
| Delacour | DERK2 | 1 | EOL/TILL | EV/MU | B,C | well, sig poorly drained | DEL OBL 20-40<br>RKV OBL 20-40 | IND HULG 20-40<br>EBO RBL 0-20 |
| DeWinton | DWHP1 | 2H | LAC-FG | LV/FGU | B,C | poorly, with better drained knolls | DWT RHG 50-70<br>HPV RBL 20-40 | EBO RBL 0-10<br>DEL OBL 0-10 |
| DeWinton | DWT1 | 2H | LAC/TILL | LV/ML | A,B | poorly drained | DWT RHG 60-80 | HULG 10-30 |
| DeWinton | DWT2 | 2H | LAC/<br>TILL/R | LV/MV/R | A | poorly drained | DWT RHG 30-50<br>lithic phases 30-50 | HULG 10-30 |
| DeWinton | DWT3 | 2H | PT/LAC/T | OV/LB/ML | A | very poorly drained | DWT RHG 40-60<br>TM 0-20 | peaty phases 20-40 |
| Dunvargan | DVFS1 | 3H | TILL-LG | MH-LGH | D,E | well, sig poorly drained | DVG OBL 30-50<br>FSH OBL 30-50 | POT OHG 10-30 |
| Dunvargan | DVFS2 | 3H | TILL-LG | MH-LGH | D | well, sig poorly drained | DVG OBL 20-30<br>FSH OBL 20-30 | LTC DLG 10-30<br>ELB DGL 10-30<br>POT OHG 10-30 |
| Dunvargan | DVG1 | 3H | TILL | MU-MM | C,D,E | well | DVG OBL 60-80<br>ODG 10-30 | slope wash<br>gleyed soils |
| Dunvargan | DVG2 | 3H | TILL | MU-MM | C,D | well, sig poorly drained | DVG OBL 50-70<br>ODG 10-30 | OHG 20-30 |
| Dunvargan | DVG3 | 3H | TILL/R | MBV/RI | E,F,G | well to rapid, surface runoff reduces infiltration | DVG OBL 40-60<br>LTC DGL 20-40 | lithic phases<br>slope wash |
| Dunvargan | DVG4 | 3H | TILL | MH-MR | C,D | well,minor poorly drained | DVG OBL 30-50<br>RBL 20-40 | thin phases<br>gleyed phases |
| Eastbow | EBAD1 | 1 | EOL/<br>FG/T | EV/FGV/MU | C | well to rapidly | EBO RBL 30-50<br>ADY OBL 10-30 | HPV RBL 10-30<br>RKV OBL 0-20<br>MDP OBL 0-20 |
| Eastbow | EBAD2 | 1 | EOL/<br>FG/T | EV/FGV/MU | D | well to rapidly, sig poorly drained | EBO RBL 30-40<br>ADY OBL 20-40 | HPV RBL 10-30<br>DWT RHG 10-30 |
| Elbow | ELRS1 | 5H | LG/TILL | LGV/M | C,D,E | moderately well | ELB DGL 20-40<br>RSN DGL 20-40 | OGL 10-30<br>DGL 10-30 |
| Elbow | ELRS2 | 5H | LG/<br>TIL/FG | LGV/MV/<br>FGV/R | C | moderately well | ELB DGL 20-40<br>RSN DGL 20-40 | OGL 10-20<br>OGL 10-20 |
| Elbow | ELRS3 | 5H | LG/<br>TILL/R | LGV/MB/RI | E,F,G | well to rapid, surface runoff reduces infiltration | ELB DGL 20-30<br>RSN DGL 20-30 | OGL 10-20<br>OGL 10-20<br>slope wash |
| Elbow | ELRS4 | 5H | LG/ | LGV/MV/FG | C,D | moderately well, some poorly | ELB DGL 15-30<br>RSN DGL 15-30 | OGL 20-40<br>sandy subsoil variants 10-20<br>OLG 1-20 |
| Fish Creek | FSH1* | 3H | LG | LGU-LGM | B,C,D | moderately well | FSH OBL 65-86 | EBL 14-35 |
| Fish Creek | FSH2* | 3H | LG | LGU | B,C,D | moderately well, sig poorly drained | FSH OBL 24-50 | RBL 14-35<br>POT OHG 15-35 |
| Fish Creek | FSH3* | 3H | LG/TILL | LGV/MU-M | C,D | moderately well | FSH OBL 30-65 | till subsoil variants 30-50 |
| Fish Creek | FSH4 | 3H | LG/TILL | LGV/MU-M | C,D | moderately well, sig poorly drained | FSH OBL 40-60<br>till subsoil variants 20-40 | POT OHG 10-30 |
| Fish Creek | FSH5 | 5H | LG | LGU-LGM | D | moderately well | FSH OBL 40-60<br>ELB DGL 30-50 | POT OHG 10-30 |

## Appendix E. (continued)

**Symbol legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | PM | Landform | Slope | Drainage | Major soils | Minor soils |
|---|---|---|---|---|---|---|---|---|
| Happy Valley | HPAD1 | 1 | FG-TILL | EV/FGV/MU | C,D | well to rapidly | HPV RBL 30-50<br>ADY OBL 10-30 | EBO RBL 10-30<br>MDP OBL 10-30 |
| Happy Valley | HPAD3 | 1 | FG-TILL | FGH-ML | D,E | well, minor, poorly drained | HPV RBL 30-60<br>ADY RBL 10-30 | SHL RBL 10-30<br>EBO RBL 10-20 |
| Happy Valley | HPAD4 | 1 | FG/TILL | FGV/MI | E | rapid surface runoff | HPV RBL 40-60<br>ADY OBL 10-30 | EBO RBL 10-30<br>SHL RBL 0-20 |
| Happy Valley | HPSC1 | 1 | FG | FGT-FF | D | rapid | HPV RBL 40-60<br>SCO OBL 20-40 | MDP OBL 0-20<br>EBO RBL 0-20 |
| Happy Valley | HPV1 | 1 | FG | EV/FGU | B,C | rapidly | HPV RBL 40-70<br>EBO RBL 10-40 | MDP OBL 10-30<br>OR 0-20 |
| Happy Valley | HPV2 | 1 | FG | EV/FGR-I | D,E | very rapid | HPV RBL 40-80<br>EBO RBL 10-30 | OR 10-30<br>MDP OBL 0-20 |
| Happy Valley | HPV3 | 1 | FG | FGH | D | rapidly drained | HPV RBL 50-80<br>EBO RBL 10-30 | OR 10-30<br>MDP OBL 0-20 |
| Highwood | HIBO1 | 1 | FG | FGT | B,C | rapid | HIW RBL 30-50<br>gravel subsoil variant 20-40 | BOV OBL 10-40<br>MDP OBL 0-20 |
| Highwood | HIW1 | 1 | FG | FGT | B,C | well to rapidly | HIW RBL 30-70<br>OHR 20-40 | MDP OBL 10-30<br>EBO RBL 0-20 |
| Indus | IND1 | 1 | TILL | ML | A,B | poorly, gw recharge areas | IND HULG 80-100 | better drained soils |
| Indus | IND2 | 1 | TILL | MU-MH | B,C | poorly, sig well drained | IND HULG 50-70<br>DEL OBL 20-40 | SHL RBL 0-20 |
| Leighton Centre | LTC1* | 3H | TILL/R | MBV/RI | E,F,G | well to rapid, surface runoff reduces infiltration | LTC DGL 15-40<br>OGL 10-30 | lithic phases<br>slope wash |
| Leighton Centre | LTC2 | 3H | TILL | MU-MH/R | C,D | well | LTC DGL 40-60<br>DGL 10-30 | DVG OBL 10-30<br>DWT HULG 5-15 |
| Lloyd Lake | LLK1* | 2 | LG | LGU-LGM | B,C,D | well | LLK OBL 30-54<br>BPW RBL 18-40 | CABL 8-28 |
| Lloyd Lake | LLK2 | 2 | LG | LGB/TILL | B | moderately well, sig. poorly drained | LLK OBL 30-50<br>GLB LSS 10-30 | GLS ZBL 10-30<br>BZC RHG 10-30 |
| Lloyd Lake | LLK3 | 2 | LG/TILL | LGBV/MI | D,E,F | well to rapid, surface runoff reduces infiltration | LLK OBL 30-50<br>BPW RBL 20-40 | till subsoil variants slope wash |
| Lloyd Lake | LLK4 | 2 | LG/FG | LGBV/FT | C | well | LLK OBL 40-60<br>BPW RBL 30-40 | gravel subsoil variants<br>BOV OBL 10-20 |
| Mesa Butte | MSB1 | 5H | COL/R | CV/RR | F,G,H | well to rapid, surface runoff reduces infiltration | MSB OBL 30-50<br>OEB 20-40 | SPR OGL 0-20<br>DVG OBL 0-20<br>slope wash |
| Midnapore | MD-L1 | 2H | FG/R | FVG/RL-R | C | well to rapidly | lithic phases 70-90 | MDP OBL 0-20<br>RBL 0-20 |
| Midnapore | MDAD1 | 1 | FG/TILL | FGV/MU | C,D | well to rapidly | MDP OBL 40-60<br>ADY OBL 10-30 | RKV OBL 10-30<br>HPV RBL 0-20<br>till subsoil variants |
| Midnapore | MDP1 | 1 | FG | FGU-FGM | C,D | well to rapidly | MDP OBL 50-70<br>RKV OBL 20-40 | HPV RBL 0-20 |
| Midnapore | MDP2 | 1 | FG | FGU-FGH | D | well, sig poorly drained | MDP OBL 40-60<br>RKV OBL 10-30 | DWT RHG 10-30<br>HPV RBL 0-20 |
| Nose Creek | NSK1 | 2H | TILL/R | MBV/RL | C | well | NSK RBL 30-50<br>OBL 20-40 | TWS OBL 10-30<br>lithic phases |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | PM | Landform | Slope | Drainage | Major soils | Minor soils |
|---|---|---|---|---|---|---|---|---|
| Nose Creek | NSK2 | 2H | TILL/R | MBV/RL-V | B-D | well, sig poorly drained | NSK RBL 20-40 OBL 10-30 | TWS OBL 10-30 BZC RHG 10-30 lithic phases |
| Nose Creek | NSK3 | 2H | TILL/R | MBV/RL | B | well, sig poorly drained | NSK RBL 40-60 GLBLSZ 20-40 | BZC RHG 10-30 |
| Organics | TM1 | 5H | ORG/LAC | BH | A | very poorly drained | TM 60-80 TYM 20-40 | OHG/P 0-20 |
| Pothole Creek | POT1 | 5H | L-LG | LB/LGL | A,B | poorly some very poorly | POT OHG 70-90 | peaty phases |
| Pothole Creek | POT2 | 5H | L-LG | LB/LGL-U | A,B,C | poorly, sig better drained | POT OHG 50-70 | FSH OBL 10-30 GLBL 10-30 |
| Pothole Creek | POT3 | 5H | FL-LG | FV/LGL-U | B-D | poorly, sig better drained | POT OHG 30-50 SRC OBL 10-30 | FSH OBL 10-30 GLBL 10-30 |
| Rockyview | RKAD1* | 1 | EOL/TILL | EV/MU | C,D | well | RKV OBL 30-60 ADY OBL 18-40 | EBO RBL 0-20 SHL RBL 0-20 |
| Rockyview | RKAD2 | 1 | EOL/TILL | EV/MU | C,D | well, sig undrained dep | RKV OBL 30-50 ADY OBL 20-40 | BZC RHG 15-30 EBO RBL 0-20 |
| Rockyview | RKAD3 | 1 | EOL/TILL | EV/MB/R | E,F | well to rapid, surface runoff reduces infiltration | RKV OBL 30-50 ADY RBL 20-40 SHL OBL 10-30 | slope wash lithic phases |
| Rockyview | RKAD4 | 1 | EOL/TILL | EV/MU | C | moderately well, discharge spots | RKV OBL 30-50 ADY OBL 20-40 | BED BLSS 10-30 EBO RBL 0-20 SHL RBL 0-20 |
| Rockyview | RKAD5 | 1 | EOL/TILL | EV/MU | C,D | well | RKV OBL 20-40 ADY OBL 10-30 | SHL RBL 15-30 EBO RBL 15-30 eroded and gleyed phases |
| Rough Broken | RB1 | all | TILL | MI-MB/RI | E,F,GH | well to rapid, surface runoff reduces infiltration | undefined | undefined |
| Rough Broken | RB2 | all | COL/R | CV/RS | F,G,H | well to rapid, surface runoff reduces infiltration | undefined | undefined |
| Rough Broken | RB4 | all | TILL-FL | FL-MI | DE,F, GH | well, central drainage channel | undefined | undefined |
| Rough Broken | RB5 | all | LG-FG | LGI-S | F,G,H | well to rapid, surface runoff inhibits infiltration | undefined | undefined |
| Sarcee | SRC1* | 3H | FL | FT-FF | B | well | SRC OBL25-55 RBL 10-40 | gravel subsoil variants |
| Sarcee | SRC2 | 3H | FL | FL-V | BD | well, sig drained | SRC OBL 30-50 | CUHR 20-40 RHG 20-40 |
| Sarcee | SRC3 | 3H | FL/FG | FV/FGT | B | well to rapidly | SRC OBL 20-40 RBL 10-30 | gravel subsoil variants 20-40 SUD ODG 10-30 |
| Sarcee | SRC4 | 3H | FL/FG | FV/FGL-V | BD | well, sig poorly drained | SRC OBL 10-30 CUHR 10-30 | gravel subsoil variants 20-40 RHG 10-30 |
| Spruce Ridge | SPR1* | 5H | TILL/R | MBV/RR | D to H | well | SPR OGL 39-65 EEB 10-30 | slope wash lithic phases |
| Spruce Ridge | SPR2 | 5H | TILL/R | MBV/RR | DEFG | well | SPR OGL 30-50 DGL 20-40 | slope wash lithic phases |
| Spy Hill | SPY1 | 3H | TILL | MH | D,E,FG | well, minor poorly drained | SPY OBL 40-60 RBL 20-40 | ODG 0-20 POT OHG 0-15 |

## Appendix E. (continued)

**Descriptive legend: Calgary urban perimeter soil survey**

| Soil group | Unit | Zone | PM | Landform | Slope | Drainage | Major soils | Minor soils |
|---|---|---|---|---|---|---|---|---|
| Spy Hill | SPY2 | 3H | TILL | MH | D,E,F | well, sig poorly drained | SPY OBL 30-50<br>POT OHG 15-40 | ODG 0-20<br>RBL 10-30 |
| Strathcona | SCO1 | 2H | FG | FGF-FGR | C,D | rapid internal drainage | SCO OBL 80-100 | sandy variants<br>eroded phases |
| Strathcona | SCO2 | 2H | FG | FGF-FGR | C,D,E | rapid internal drainage | SCO OBL 50-70 | sandy variants |
| Strathcona | SCO3 | 2H | FG/TILL | FGV/MB/R | BC,DE | well, minor poorly drained | SCO OBL 30-50<br>sandy variants | till subsoil variants<br>lithic phases |
| Sundre | SUD1 | 5H | FG | FGT | B | rapid internal, high w.t | SUD ODG 70-90 | SRC OBL 10-30 |
| Tweedsmuir | TWS1 | 2H | FL | FT | B,C,D | well | TWO OBL 60-80 | RBL 0-30<br>CUHR 0-30 |
| Terric Mesisol | TM1 | 5H | PT | BI | A | very poorly, permanently wet | unnamed organic soils | POT OHG 10-30<br>peaty gleysols |
| Tweedsmuir | TWS2 | 2H | FL | FL-V | BD | well, sig poorly drained | TWS OBL 30-50<br>CUHR 20-40 | OHG 10-30<br>gleyed variants |
| Twin Bridges | TBR1 | 3H | FL-FG | FBV/FGL-V | BD | well, high water table | TBR GLHR 30-60<br>AV OR 20-40 | RHG 10-30 |

*Estimates of series composition for these soil units were made using the transect method and are considered to be more accurate than those which did not utilize this sampling technique.

# Glossary

*AASHO classification (soil engineering)* - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Officials.

*accretion* - The gradual addition of new land to old by the deposition of sediments.

*adsorption complex* - The group of substances in the soil capable of adsorbing water and nutrients.

*aeolian (eolian)* - Material accumulated through wind action; includes both loess and dune sand.

*aeration, soil* - The process by which air in the soil is replaced by air from the atmosphere. The rate of aeration depends largely on the volume and continuity of pores in the soil.

*aggregate, soil* - A group of soil particles cohering so as to behave mechanically as a unit.

*alkalization* - The process whereby the exchangeable sodium content of a soil is increased.

*alkaline soil* - A soil having a pH greater than seven.

*alluvium* - A general term for all detrital material deposited or in transit by streams, including gravel, sand, silt, clay and all variations and mixtures of these.

*anion* - An ion carrying a negative charge of electricity. The common soil anions are carbonate, sulfate, chloride and hydroxyl.

*Atterberg limits* - Various moisture contents at which a soil changes from one major physical state to another. The Atterberg limits which are most useful for engineering purposes are liquid limit, plastic limit, and plasticity index (q.v.).

*available soil moisture* - The portion of water in a soil that can be readily absorbed by plant roots; generally considered to be that water held in the soil against a pressure of up to approximately 15 bars.

*available nutrient* - That portion of any element or compound in the soil that can readily be absorbed and assimilated by growing plants.

*base saturation percentage* - The extent to which the adsorption complex of a soil is saturated with exchangeable cations other than hydrogen and aluminum.

*bearing capacity* - The maximum load that a material can support before failing.

*bed* - A unit layer 1 cm or more thick that is visually or physically more or less distinctly separable from other layers above and below in a stratified sequence.

*bedrock* - The solid rock underlying soils and the regolith in depths ranging from zero (where exposed to erosion) to several hundred meters.

*blanket* - A term used to describe a mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit but which still conforms to the general underlying topography.

*blowout* - A small area from which soil material has been removed by wind.

*bottomland* - See floodplain.

*boulders* - Stones which are larger than 60 cm in diameter.

*boundary, horizon* - The contact plane between soil horizons which is described by indicating its distinctness and form.

Distinctness
- abrupt: less than 2.5 cm wide.
- clear: 2.5 to 6 cm wide.
- gradual: 6 to 13 cm wide.
- diffuse: more than 13 cm wide.

Form
- smooth: nearly a plane
- wavy: pockets are wider than deep
- irregular: pockets are deeper than wide
- broken: some parts are unconnected

*bulk density, soil* - The mass of dry soil per unit bulk volume.

*calcareous classes* - The calcareous classes, expressed in terms of $CaCO_3$ equivalent are: weakly (<6 percent), moderately (6 to 15 percent), strongly (16 to 25 percent), very strongly (26 to 40 percent), and extremely (>40 percent).

*calcareous soil* - Soil containing sufficient calcium carbonate, often with magnesium carbonate, to effervesce visibly when treated with cold 0.1N hydrochloric acid.

*calcium carbonate equivalent* - The total inorganic carbon content of soil material expressed in terms of percent calcium carbonate ($CaCO_3$).

*cation* - An ion carrying a positive charge of electricity. The common soil cations are calcium, magnesium, sodium, potassium and hydrogen.

*cation exchange* - The interchange between a cation in solution and another on the surface of any surface-active material in the soil such as clay or organic matter.

*cation exchange capacity (total exchange capacity)* -The total amount of exchangeable cations that a soil can adsorb. It is expressed in milliequivalents per 100 g of soil.

*chroma* - The relative purity, strength or saturation of a color. It is directly related to the dominance of the determining wavelength of light.

*classification, soil* - The systematic arrangement of soils into categories on the basis of their characteristics. See The Canadian System of Soil Classification (CSSC, 1978) and Glossary of Terms in Soil Science (Agriculture Canada, 1976).

*clay* - (i) As a particle-size term: a size fraction less than 0.002 mm in equivalent diameter, or some other limit (geologists and engineers). (ii) As a rock term: A natural, earth, fine-grained material that develops

plasticity with a small amount of water. (iii) As a soil term: a textural class. See also texture, soil. (iv) As a soil separate: a material usually consisting largely of clay minerals, but commonly also of amorphous free oxides and primary minerals.

*clay films (skins)* - Coatings of oriented clays on the surface of soil peds and mineral grains, and in soil pores.

*clay mineral* - Finely crystalline hydrous aluminum silicates and hydrous magnesium silicates with a phyllosilicate structure.

*clastic* - Composed of broken fragments of rocks and minerals.

*climatic moisture index* - An expression of the percentage contribution of precipitation in the growing season to the total amount of water required by a crop if lack of water is not to limit its production.

*climax vegetation* - Stable, self-perpetuating plant communities that are the end products of plant succession.

*coarse fragments* - Rock or mineral fragments greater than 2.0 mm in diameter.

*cobbly* - Containing appreciable quantities of rounded or subrounded coarse rock or mineral fragments 8 to 25 cm in diameter. "Angular cobbly" is used when the fragments are less rounded.

*colloid, soil* - Organic or inorganic matter having very small particle size and correspondingly large surface area per unit of mass. Most colloidal particles are too small to be seen with the ordinary compound microscope.

*color* - See Munsell color system. consistence - (i) The resistance of a material to deformation or rupture. (ii) The degree of cohesion or adhesion of the soil mass. Terms used for describing consistence at various soil moisture contents are: wet soil - nonsticky, slightly sticky, sticky, and very sticky moist soil - loose, very friable, friable, firm, and very firm dry soil - loose, soft, slightly hard, hard, very hard, and extremely hard.

*control section, soil* - The vertical section upon which the taxonomic classification of soil is based. The control section usually extends to a depth of 100 cm in mineral materials and to 160 cm in organic materials.

*creep* - The slow downward movement of soil and rock fragments on a slope.

*cretaceous* - See Geological Time Scale.

*crevasse fillings* - Ridges or hummocks formed from glacial sediments that were deposited by water in the cracks and crevasses of the ice.

*degree days* - The difference between the mean daily temperature and a selected standard temperature, accumulated daily over a period of time, such as the growing season.

*delta* - The accumulation of sediments where a stream empties into a body of quiet water, resulting in the building out of the shoreline.

*deposition* - The accumulation of material left in a new position by a natural transporting agent such as water, wind, ice or gravity; or by the activity of man.

*drainage* - The removal of excess surface water or groundwater from land by natural runoff and percolation, or by means of surface or subsurface drains.

*drift, glacial* - All material moved by glaciers and by the action of meltwater streams and associated lakes.

*droughty soil* - Sandy or very rapidly drained soil.

*drumlin* - An elongated or oval hill of glacial drift, commonly till, deposited by glacier ice with its long axis parallel to the direction of ice movement.

*eluvial horizon* - A soil horizon that has been formed by the process of eluviation.

*eluviation* - The transportation of soil material in suspension or in solution within the soil by the downward or lateral movement of water.

*erosion* - The wearing away of the land surface by running water, wind, ice or other geological agents, including such processes as gravitational creep.

*erratic* - A rock fragment carried by glacier ice or floating ice and deposited when the ice melted at some distance from the outcrop from which the fragment was derived.

*escarpment* - A steep face or ridge of high land.

*esker* - A winding ridge of irregularly stratified sand, gravel and cobbles deposited under the ice by a rapidly flowing glacial stream.

*evapotranspiration* - The combined loss of water from a given area and during a specific period of time, by evaporation from the soil surface and by transpiration from plants.

*exchangeable cation* - A cation that is held by the adsorption complex of the soil and is easily exchanged with other cations of neutral salt solutions.

*fan* - An accumulation of debris brought down by a stream on a steep gradient and debouching on a gently sloping plain in the shape of a fan, forming a section of a very low cone.

*fertility, soil* - The status of a soil in relation to the amount and availability to plants of elements necessary for plant growth.

*fertilizer* - Any organic or inorganic material of natural or synthetic origin that is added to a soil to supply elements essential to plant growth.

*field capacity* - The percentage of water remaining in the soil two or three days after the soil has been saturated, and free drainage has practically ceased.

*fiber, rubbed or unrubbed* - The organic material retained on 100-mesh sieve (0.15 mm) either with or without rubbing, except for wood fragments that cannot be crushed in the hand and are larger than 2 mm in the smallest dimension.

*floodplain* - The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

*flowtill* - A superglacial till that is modified and transported by plastic mass flow.

*flutings* - Groups of ridge-like and groove-like glacial landforms combining to impart a fluted pattern to the surface.

*fluvial deposits* - All sediments, past and present, deposited by flowing water, including glaciofluvial deposits.

*forb* - A herbaceous plant which is not a grass, sedge or rush.

*frost-free period* - The period or season of the year between the last spring frost and the first autumn frost.

*frost heave* - The raising of a surface due to the accumulation of ice in the underlying soil.

*fungi* - The allophytic plants that lack chlorophyll and are filamentous in structure; molds.

*genesis, soil* - The mode of origin of the soil, especially the processes or soil forming factors responsible for development of the solum from unconsolidated parent material.

*Geological Time Scale* - see figure 14.

*gley* - Gleying is a reduction process that takes place in soils that are saturated with water for long periods of time. The horizon of most intense reduction is characterized by a gray, commonly mottled appearance, which on drying shows numerous rusty brown iron stains or streaks. Those horizons in which gleying is intense are designated with the subscript "g".

*gleysolic soil* - Soil developed under wet conditions resulting in reduction of iron and other elements and in gray colors and mottles.

*Glaciofluvial* - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may be in the form of outwash plains, deltas, kames, eskers, and kame terraces.

*glaciolacustrine* - Lacustrine deposits laid down in glacial times.

*grain size* - The effective diameter of a particle measured by sedimentation, sieving or micrometric methods.

*grass* - Plant of a large family characterized by rounded and hollow jointed stems, narrow sheathing leaves, flowers borne in spikes and hard grain-like seeds.

*gravel* - Rock or mineral fragments 2 mm to 8 cm in diameter.

*gravelly* - Containing appreciable quantities of rounded or subrounded coarse rock or mineral fragments 2 mm to 8 cm in diameter. 'Angular gravelly' is used when the fragments are less rounded.

*great group* - A category in the Canadian system of soil classification. It is a taxonomic grouping of soils having certain morphological features in common and a similar pedogenic environment.

*green manure* - Plant material incorporated into the soil to improve it, while the plant material is still green.

*ground moraine* - The rock debris deposited or released from glacial ice during ablation, to form an extensive, fairly even thin layer of till, having a gently rolling surface and low relief.

*groundwater* - Water that is passing through or standing in the soil and the underlying strata in the zone of saturation. It is free to move by gravity.

*growing season* - Period with soil temperatures over 5°C at a depth of 50 cm.

*hardpan layers* - Horizons or layers in soils that are strongly compacted, indurated or very high in clay content.

*herb* - Any flowering plant except those developing persistent woody bases and stems above ground.

*horizon, soil* - See table 6.

*hue* - The aspect of color that is determined by the wavelengths of light and changes with the wavelength. Munsell hue notations indicate the visual relationship of a color to red, yellow, green, blue or purple, or an intermediate of these hues.

*humification* - The processes by which organic matter decomposes to form humus.

*hummocky moraine* - An area of knob and kettle topography that may have been formed either along a live ice front or around masses of stagnant ice.

*humus* - (1) The fraction of the soil organic matter that remains after most of the added plant and animal residues have decomposed. It is usually dark colored. (2) Humus is also used in a broader sense to designate the humus forms referred to as forest humus. (3) All the dead organic material on and in the soil that undergoes continuous breakdown, change and synthesis.

*igneous rock* - Rock formed by solidification from a molten or partially molten state.

*illuvial horizon* - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension as a layer of accumulation.

*illuviation* - The process of depositing soil material removed from one horizon in the soil to another, usually from an upper to a lower horizon in the soil profile. Illuvial substances include silicate clay, hydrous oxides of iron and aluminum and organic matter.

*impeding horizon* - A horizon which hinders the movement of water by gravity through soils.

*infiltration* - The downward entry of water into the soil.

*irrigation* - The artificial application of water to the soil for the benefit of growing crops.

*jurassic* - See Geological Time Scale.

*kame* - A conical hill or short irregular ridge of stratified gravel or sand deposited by glacial meltwater in contact with glacier ice.
*kame terrace* - A terrace-like ridge consisting of stratified sand and gravel deposited by a meltwater stream between a melting glacier or a stagnant ice lobe and a higher valley wall or lateral moraine, and left standing after the disappearance of the ice.

*kettle* - A steep-sided, usually basin- or bowl-shaped hole or depression without surface drainage in glacial drift deposits.

*lacustrine deposit* - Material deposited in lakewater and later exposed either by lowering the water table or by uplift of the land. The sediments range in texture from sands to clays.

*lacustro till* - A glacial deposit that looks like lacustrine material, has a texture of clay and contains a few stones.

*laminations* - Layering or bedding less than 1 cm thick in a stratified sequence.

*landforms* - The various shapes of the land surface resulting from a variety of actions such as deposition or sedimentation (eskers, lacustrine basins), erosion (gullies, canyons), and earth crust movements (mountains).

*leaching* - The downward movement within the soil of materials in solution.

*lessivage* - The washing in suspension of fine clay and lesser amounts of coarse clay and fine silt down cracks and other voids in a soil body.
*lime (in soil)* - A soil constituent consisting principally of calcium carbonate; and including magnesium carbonate, and perhaps the oxide and hydroxide of calcium and magnesium.

*limestone* - A sedimentary rock composed of calcium carbonate.

*liquid limit* - (i) The water content corresponding to an arbitrary limit between the liquid and plastic states of consistence of a soil. (ii) The water content at which a pat of soil, cut by a standard-sized groove, will flow together for a distance of 12 mm hinder the impact of 25 blows in a standard liquid-limit apparatus.

*lithic layer* - Bedrock under the control section of a soil. In Organic soils, bedrock occurring within a depth of between 10 cm and 160 cm from the surface.

*lithic phase (of soil)* - Any mineral soil having consolidated bedrock within the control section below a depth of 10 cm.

*loess* - Material transported and deposited by wind, and consisting of predominantly silt sized particles.

*macrostructure (primary structure)* - Refers to the larger peds of soil horizons that break down to smaller peds.

*map unit* - A combination of kinds of soil, or miscellaneous land type or types that can be shown at the scale of mapping for the defined purpose and objectives of a particular soil survey. (Combination of kinds of soil includes groupings of soil series, soil associations, soil catenas or undifferentiated soils appropriate for use at the scale of mapping being carried out). Soil map units are the basis for the delineations of a soil survey map and are most commonly set up where two or more defined soil series are so intimately intermixed geographically that it is impractical, because of the scale used, to separate them. Map units normally contain inclusions of soils outside the limits of the taxonomic name or names used to define the map unit. Map units are generally designed to reflect significant differences in use and management.

*marsh* - Periodically flooded or continually wet areas having the surface not deeply submerged. It is covered dominantly with sedges, cattails, rushes or other hydrophytic plants.

*matrix, soil* - The main soil constituent or material that encloses other soil features, for example, concretions embedded in a fine-grained matrix.

*meander* - One of a series of loop-like bends in the course of a stream.

*meander scar* - An abandoned meander that has been cut off from the main course of a stream by erosion.

*mesostructure (secondary structure)* - Refers to the smaller peds of soil horizons that result from the breakdown of larger peds.

*metamorphic rock* - Rock derived from pre-existing rocks, but that differs from them in physical, chemical and mineralogical properties as a result of natural geological processes, principally heat and pressure, originating within the earth.

*mesozoic* - See Geological Time Scale.

*microclimate* - (i) The climate of a small area resulting from the modification of the general climate by local differences in elevation or exposure. (ii) The sequence of atmospheric changes within a very small region.

*microrelief* - Small scale, local differences in relief, including mounds, swales, or hollows.

*milliequivalent (me)* - One one-thousandth of the equivalent weight of a molecule.

*mineral* - A naturally formed chemical element or compound having a definite chemical composition, and usually a characteristic crystal form.

*mineral soil* - A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter.

*moraine* - A mound, ridge or other distinct accumulation of unsorted, unstratified glacial drift, predominantly till, deposited chiefly by direct action of glacial ice in a variety of topographic landforms.
*morphology, soil* - The physical constitution, particularly the structural properties, of a soil profile as exhibited

by the kinds, thickness and arrangement of the horizons in the profile; and by the texture, structure, consistence and porosity of each horizon.

*mottling* - Spotting and blotching of different color or shades of color interspersed with the dominant color. Mottling in soil is usually considered to indicate poor aeration and drainage.

*muck* - Fairly well decomposed organic soil material relatively high in mineral content, dark in color, and accumulated under conditions of imperfect drainage.

*Munsell color systems* - A color designation system specifying the relative degrees of the three simple variables of color: hue, value and chroma (q.v.).

*nonsoil* - The aggregate of surficial materials that do not meet the definition of soil.

*order, soil* - a category in the Canadian system of soil classification. All the soils within an order have one or more characteristics in common.

*organic carbon, soil* - The percent by weight of carbon in organic forms in soil materials, determined by the difference between total carbon (determined by dry combustion) and inorganic carbon (determined by acid dissolution).

*organic matter, soil* - The organic fraction of the soil; included plant and animal residues at various stages of decomposition, cells and tissues of soil organisms and substances synthesized by the soil population. It is estimated by multiplying the soil organic carbon content by 1.724.

*orthic* - A subgroup referring to the modal or central concept of various great groups in the Brunisolic, Chernozemic, Cryosolic, Gleysolic, Luvisolic, Podzolic and Regosolic orders of the Canadian system of soil classification.

*outcrop* - That part of a geologic formation or structure that appears at the surface of the earth.

*outwash* - Stratified detritus (chiefly sand and gravel) washed out from a glacier by meltwater streams and deposited in front of or beyond the terminal moraine of an active glacier.

*parent material* - The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil is developed by pedogenic processes.

*particle-size analysis* - The determination of the various amounts of the different separates in a soil sample, usually by sedimentation, sieving, micrometry or combinations of these methods. Has been called grain-size analysis or mechanical analysis.

*particle-size classes (for soil families and parent materials)* - Groupings of particle-size distribution of the whole soil or soil material including the coarse fraction. They are used for generalized descriptions of soils, and differ from texture which refers to the fine earth fraction (<2 mm) only. The classes are described as follows:

Fragmental - Stones, cobbles and gravel, with too little fine earth to fill interstices larger than 1 mm.

Sandy-skeletal - particles coarser than 2 mm occupy 35 percent or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the sandy particle-size class.

Loamy-skeletal - Particles 2 mm to 25 cm occupy 35 percent or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the loam particle-size class.

Clayey-skeletal - Particles 2 mm to 25 cm occupy 35 percent or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the clayey particle-size class.

Sandy - The texture of the fine earth includes sands and loamy sands, exclusive of loamy very fine sand and very fine sand textures; particles 2 mm to 25 cm occupy less than 35 percent by volume.

Loamy - The texture of the fine earth includes loamy very fine sand, very fine sand and finer textures with less than 35 percent clay; particles 2 mm to 25 cm occupy less than 35 percent by volume.

Coarse-loamy. A loamy particle size that has 15 percent or more by weight of fine sand (0.25 to 0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18 percent clay in the fine earth fraction.

Fine-loamy. A loamy particle size that has 15 percent or more by weight of fine sand (0.25 to 0.1 mm) or coarser particles, including fragments up to 7.5 cm and has 18 to 35 percent clay in the fine earth fraction.

Coarse-silty. A loamy particle size that has less than 15 percent of fine sand (0.25 to 0.1 mm) or coarser particles, including fragments up to 7.5 cm and has less than 18 percent clay in the fine earth fraction.

Fine-silty. A loamy particle size that has less than 15 percent of fine sand (0.25 to 0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18 to 35 percent clay in the fine earth fraction.

Clayey - The fine earth contains 35 percent or more clay by weight and particles 2 mm to 25 cm occupy less than 35 percent by volume.

Fine-clayey. A clayey particle size that has 35 to 60 percent clay in the fine earth fraction.

Very-fine-clayey. A clayey particle size that has 60 percent or more clay in the fine earth fraction.

*particle-size distribution* - The amounts of the various soil separates in a soil sample, usually expressed as weight percentages.

*peat* - Unconsolidated soil material consisting largely of undecomposed, or only slightly decomposed, organic material.

*ped, soil* - A unit of soil structure such as a prism, block or granule, which is formed by natural processes.

*pedogenic* - Pertaining to the mode of origin of the soil, especially the processes or soil forming factors responsible for the development of the solum.

*pedologist* - A person who specializes in those aspects of soil science dealing with the origin, morphology,

genesis, mapping and taxonomy of soils; and classification in terms of their use.

*pedon* - A three dimensional soil unit. Its lower limit is the vague and arbitrary depth between soil and nonsoil and the upper limit is its contact with air or water. The lateral dimensions are large enough to permit study of the nature of the range in horizon variability that occurs within a small area.

*perched water table* - A water table due to the 'perching' of water on a relatively impermeable layer at some depth within the soil. The soil within or below the impermeable layer is not saturated with water.

*percolation* - The downward movement of water through saturated or nearly saturated soil.

*permeability, soil* - The ease with which gases and liquids penetrate or pass through a bulk mass of soil or a layer of soil. Because different soil horizons vary in permeability, the specific horizon should be designated.

*perviousness* - The potential of a soil to transmit water internally, as inferred from soil characteristics such as structure, texture, porosity, cracks, and shrink-swell properties. It is closely related to measures of permeability, percolation rate, infiltration rate and others. Perviousness classes are applied to soils, the class being controlled by the water-transmitting potential of the least permeable layer in the soil.

*pH, soil* - The negative logarithm of the hydrogen-ion activity of a soil. The degree of acidity or alkalinity of a soil as determined by means of a glass, quinhydrone or other suitable electrode or indicator at a specified moisture content or soil-water ratio and expressed in terms of the pH scale.

*palin* - Any flat area, large or small, of low elevation.

*plastic limit* - (i) The water content corresponding to an arbitrary limit between the plastic and the semi-solid states of consistence of a soil. (ii) The water content at which a soil will just begin to crumble when rolled into a thread approximately 3 mm in diameter.

*plasticity index* - The numerical difference between the liquid limit and the plastic limit.

*platy* - Consisting of soil aggregates that have developed predominantly along the horizontal axes; laminated; flaky.

*porosity, soil* - The volume percentage of the total bulk not occupied by solid particles.

*productivity, soil* - The capacity of a soil, in its normal environment, to produce a specified plant or sequence of plants under a specified system of management.

*profile, soil* - A vertical section of the soil through all its horizons and extending into the parent material.

*Quaternary* - The second period of the Cenozoic era, thought to cover the last two or three million years. (See Geological Time Scale).

*reaction, soil* - The degree of acidity or alkalinity of a soil, usually expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: extremely acid, less than 4.5; very strongly acid, 4.5 to 5.0; strongly acid, 5.1 to 5.5; moderately acid, 5.6 to 6.0; slightly acid, 6.1 to 6.5; neutral, 6.6 to 7.3; slightly alkaline, 7.4 to 7.8; moderately alkaline, 7.9 to 8.4; strongly alkaline, 8.5 to 9.0; and very strongly alkaline, greater than 9.0.

*reed* - A type of tall grass that grows in wet places.
regolith - The unconsolidated mantle of weathered rock and soil material on the earth's surface.

*relief* - The elevations or inequalities of the land surface when considered collectively.

*residual material* - Unconsolidated and partly weathered mineral materials formed by the disintegration of consolidated rock in place.

*reworked* - Descriptive of material modified after its preliminary deposition, commonly by water or wind.

*rock* - Any naturally formed, consolidated or unconsolidated material, other than soil, composed of two or more minerals or occasionally of one mineral and having some degree of chemical and mineralogic constancy.

*runoff* - The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

*saline soil* - a non-alkali soil that contains enough soluble salts to interfere with the growth of most crop plants.

*salinization* - the process of salt accumulation in soil.

*sandstone* - A sedimentary rock composed predominantly of sand sized grains of minerals and rock fragments cemented together.

*sedge* - Grass-like herb that grows in marshy places.

*sediment* - Solid material, both mineral and organic, that is in suspension, is being transported or has been removed from its site of origin by air, water, gravity or ice, and has come to rest on the earth's surface either above or below sea level.

*sedimentary rock* - Rock formed by the lithification of mechanical, chemical or organic sediments.

*seepage, soil* - The emergence of water from the soil along an extensive line of surface.

*separates, soil* - Mineral particles, less than 2.0 mm in equivalent diameter, ranging between specified size limits. The names and size limits of separates recognized by soil pedologists in Canada and the United States are: very coarse sand, 2.0 to 1.0 mm; coarse sand, 1.0 to 0.5 mm; medium sand, 0.5 to 0.25 mm; fine sand, 0.25 to 0.10 mm; very fine sand, 0.10 to 0.05 mm; silt, 0.05 to 0.002 mm; clay, less than 0.002 mm; and fine clay, less than 0.0002 mm.

*series, soil* - A category in the Canadian system of soil classification. This is the basic unit of soil classification, and consists of soils that are essentially alike in all

major profile characteristics except the texture of the surface.

*shale* - A laminated, detrital sedimentary rock in which the particles are predominantly of clay size.

*shrub* - A woody perennial plant differing from a tree by its low stature and by generally producing several basal shoots instead of a single trunk.

*sieve analysis* - A laboratory test to determine the amounts of gravel and sand fractions in a soil.

*siltstone* - A very fine-grained, consolidated, clastic rock composed predominantly of particles of silt grade.

*slope classes* - The description of an area or region in terms of the steepness of slopes. The slope classes and class limits, and descriptive terminology are:

| | Slope Class | Percent Slope | Approximate Degrees | Terminology |
|---|---|---|---|---|
| a | 1 | 0-0.5 | 0 | level |
| b | 2 | 0.5-2.5 | 0.3-1.5 | nearly level |
| c | 3 | 2-5 | 1-3 | very gentle slopes |
| d | 4 | 6-9 | 3.5-5 | gentle slopes |
| e | 5 | 10-15 | 6-8.5 | moderate slopes |
| f | 6 | 16-30 | 9-17 | strong slopes |
| g | 7 | 31-45 | 17-24 | very strong slopes |
| h | 8 | 46-70 | 25-35 | extreme slopes |
| i | 9 | 71-100 | 35-45 | steep slopes |
| j | 10 | >100 | >45 | very steep slopes |

*slump* - A landslide characterized by a shearing and rotary movement of a generally independent mass of rock or earth along a curved slip surface (concave upward) and about an axis parallel to the slope from which it descends and by backward tilting of the mass with respect to that slope so that the slump surface exhibits a reversed slope facing uphill.

*solum, soil (plural = sola)* - The upper horizons of a soil in which the parent material has been modified and in which most plant roots are contained. It usually consists of A and B horizons.

*solution, soil* - The aqueous liquid phase of the soil and its solutes consisting of ions dissociated from the surfaces of the soil particles and of other soluble materials.

*spring* - A place where groundwater flows naturally from a rock or the soil onto the land surface or into a body of surface water.

*stones* - Rock fragments greater than 25 cm in diameter if rounded and greater than 38 cm along the greater axis if flat.

*stoniness* - The relative proportion of stones in or on the soil. The stoniness classes are:

nonstony - stones cover <0.01 percent of surface and are more than 30 m apart.

lightly stony - stones cover 0.01 to 0.1 percent of surface and are 10 to 30 m apart.

moderately stony - stones cover 0.1 to 0.3 percent of surface and are 2 to 10 m apart.

very stony - stones cover 3 to 15 percent of surface and are 1 to 2 m apart.

exceedingly stony - stones cover 15 to 50 percent of surface and are 0.1 to 1 m apart.

excessively stony - stones cover >50 percent of surface and stones are less than 0.1 m apart.

*stratified drift (or sorted drift)* - Materials that are distinctly sorted according to size and weight of their component fragments, indicating a medium of transport (water or wind) more fluid than glacier ice.

*structure classes, soil* - A grouping of soil structural units or peds on the basis of size. These are tabulated under structure types, soil.

*structure grades, soil* - A grouping or classification of soil structure on the basis of inter- and intra-aggregate adhesion, cohesion, or stability within the profile. Three grades of structure designated from 1 to 3 are:

(1) weak - poorly formed, indistinct peds, barely evident in place.

(2) moderate - well-formed distinct peds, moderately durable and evident, but not distinct, in undisturbed soil.

(3) strong - durable peds that are quite evident in undisturbed soil, adhere weakly to one another, withstand displacement and become separated when the soil is disturbed.

*structure, soil* - The combination or arrangement of primary soil particles into secondary particles, units, or peds. These peds may be, but usually are not, arranged in the profile in such a manner as to give a distinctive characteristic pattern. The peds are characterized and classified on the basis of size, shape and degree of distinctness into classes, types, and grades.

*structure types, soil* - A classification of soil structure based on the shape of the aggregates or peds and their arrangement in the profile. (see CSSC, 1978).

*subgroup, soil* - A category in the Canadian system of soil classification. These soils are subdivisions of the great groups, and, therefore, each soil is defined more specifically.

*subsoil* - The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow.

*superglacial* - Carried upon, deposited from, or pertaining to the top surface of a glacier or ice sheet.

*terrace* - A nearly level, usually narrow plain bordering a lake or river.

*terric layer* - An unconsolidated mineral substratum underlying organic soil material.

*texture, soil* - The relative proportions of the various soil separates in a soil as described by the classes of soil texture. The limits of the various classes and subclasses are:

sand - Soil material that contains 85 percent or more rapid.

loamy sand - Soil material that usually contains 70 to 85 percent sand but may contain as much as 85 percent and as little as 43 percent sand depending upon the amount of clay present.

loam - Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

silt loam - Soil material that contains 50 percent or more silt and 12 to 27 percent clay, or 50 to 80 percent silt and less than 12 percent clay.

silt - Soil material that contains 80 percent or more silt and less than 12 percent clay.

sandy clay loam - Soil material that contains 20 to 35 percent clay, less than 28 percent silt and 45 percent or more sand.

silty clay - Soil material that contains 40 percent or more clay and 40 percent or more silt.

clay - Soil material that contains 40 percent or more clay, less than 45 percent sand and less than 40 percent silt.

heavy clay - Soil material that contains more than 60 percent clay.

*till* - Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel and boulders intermingled in any proportion.

*topography* - The physical features of a district or region, such as those represented on a map, taken collectively; especially the relief and contours of the land.

*topsoil* - a) The layer of soil moved in cultivation; b) the A horizon; c) the Ah horizon; d) presumably fertile soil material used to topdress roadbanks, gardens and lawns.

*triassic* - See Geological Time Scale.

*understory* - Plants that grow beneath taller plants.

*Unified Soil Classification System (engineering)* - A classification system based on the identification of soils according to their particle size, gradation, plasticity index and liquid limit. Procedures and criteria are outlined in the ASTM Book of Standards (American Society for Testing and Materials, 1979).

*USDA textural classification* - Same as soil texture as described in the Canadian System of Soil Classification (Canada Soil Survey Committee, 1978). See texture.

*valley train* - An outwash terrace extending down a valley away from the ice front.

*veneer* - A term used to describe a mantle of unconsolidated materials too thin to mask the minor irregularities of the underlying unit surface. As used in this report, a veneer is generally less than 100 cm thick and lacks a surface form typical of a particular materials genesis.

*void* - Space in a soil mass not occupied by solid mineral matter. This space may be occupied by air, water or other gaseous or liquid material.

*washboard moraine* - Several small, parallel, regularly spaced ridges that are oriented transverse to the ice movement in a general sense and that collectively resemble a washboard in pattern.

*water holding capacity* - The ability of a soil to hold water. The water holding capacity of sandy soils is usually considered to be low while that of clay is high. Often expressed in centimeters of water per meter depth of soil.

*water table* - The upper surface of groundwater or that level below which the soil is saturated with water.

*waterlogged* - Saturated with water.

*weathering* - The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

MAPS
NOT
FILMED

CARTES
OMISES